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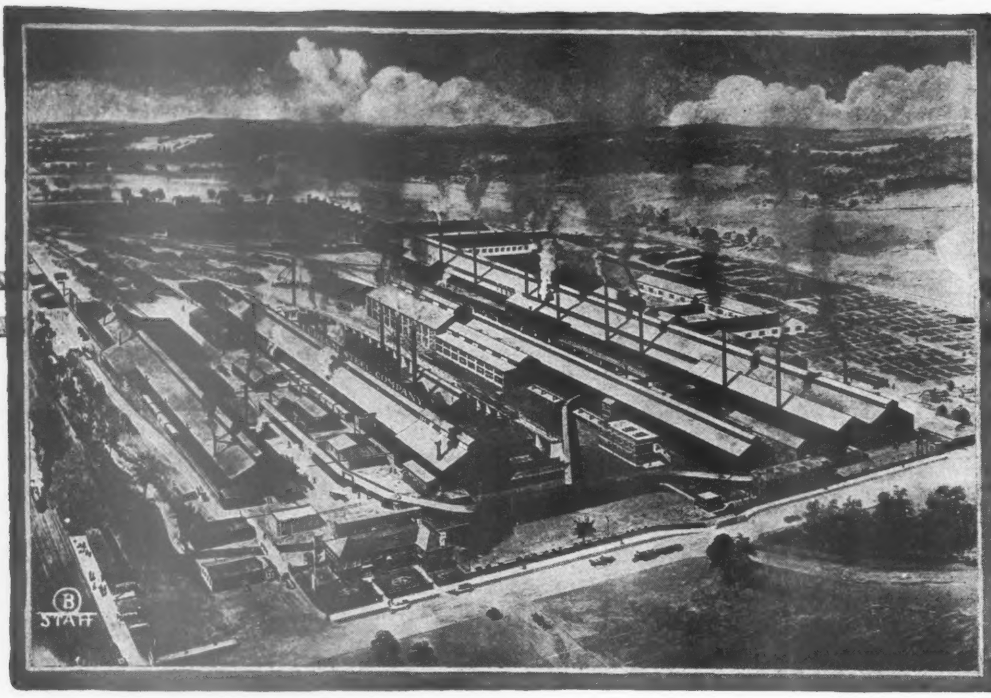

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Simple Common Sense

If the railroads are to give adequate service to the public which pays the bills, it will be absolutely necessary for the men and the managements to get together. Someone has said, "Figures don't lie, but liars figure." Some of the testimony recently introduced before the Railroad Labor Board is an insult to the intelligence of that Board and would seem to offer sufficient reason to adjudge those who gave it in contempt.

If the real reason for the long drawn-out and misleading exhibits which have been presented to the Board is to delay decisions on the part of the Board, then those who are giving the testimony should at least make a bluff at being in earnest and should talk to the point in controversy. As it is now the recent testimony of Lauck and Jewell is absurd and will react against the interests of the men these leaders are supposed to represent.

The wages of the shop crafts were increased to the present high standard for one reason only—to meet the highest cost of living recorded in recent years. We believe in paying good wages to railroad workers—wages that will enable the men to live well and that will attract the most desirable men to railroad service; but the cost of living has decreased considerably since wages were adjusted. We believe also in furnishing the public with a high grade of service at a reasonable cost, thus insuring the continued prosperity and development of the country and incidentally giving the men in railroad service steady employment. We believe also in giving the investors a fair return upon their money; if this is not done the large amount of capital necessary to improve the railroads will not be forthcoming, and incidentally the railroad employees will suffer because of business stagnation, since general business prosperity goes hand in hand with the prosperity of the railroads.

The interests of the employees, the managements, the public and the investors are so intimately associated and so dependent one upon the other, that they must work together, shoulder to shoulder, in the common interest. They must have a mutual understanding of each other's problems—this means a lot of educational work. Unless this co-operation can be brought about, sure disaster lies ahead. This is simple common sense.

The Business Situation

The latest report available as we go to press of the number of cars loaded with revenue freight is that for the week of April 16. There were 703,896 cars loaded, which is the largest number, with one exception, since the week of January 15, when 709,888 cars were loaded; the cars loaded for the week of March 5 totaled 712,822. Averaging the figures for the four weeks reported each month for the first quarter we find that the average weekly loading in January was 679,580, in February 683,088, and in March 698,627. In general coal loadings have fallen off, while merchandise, l. c. l. and miscellaneous loadings have steadily increased.

The indications are that the average weekly loading for April will be about the same as for March, although it may be larger. There are five weeks ending in April; the first week (April 2)—most of the days were in March—showed

an abnormally low figure, 666,642, the lowest this year except for the week of January 1. If this first week is disregarded, April will undoubtedly make an excellent showing compared with the earlier months of the year. The average number of cars loaded with revenue freight for the first 15 weeks of 1921 was 687,296; this compares with 798,212 for the similar period in 1920 and 698,146 in 1919. Meanwhile the money market is easier and the prices of securities are higher than for some time. The car surplus has also shown a slight decline for the first time in months. Let us hope that the worst of the depression has passed!

One Effect of Seniority Rules

One apparently unfair and certainly costly result of seniority rules has come to our attention recently in their application to apprentices. An apprentice who had just completed a four-year course and developed into a valuable man for a certain railroad was outranked in point of seniority by a mechanic who had been employed but a short time before. The result was that when a reduction in forces was made at this point, according to the seniority rule, the apprentice was allowed to go and the mechanic was retained. Furthermore when it eventually becomes necessary to re-employ men the mechanic will have to be hired back again before the apprentice. This ruling certainly seems unfair from the standpoint of the apprentice and is a costly one to the railroad. There can be no question as to the relative value of a bright apprentice who has served four years with a railroad, becoming accustomed to its equipment and standards of operation, as compared to the value of a new mechanic who has just been employed. The latter in many cases simply calls himself a mechanic and has in reality had a limited experience.

The Importance of Checking Cut-Offs

An article on "Fuel Economy by Accurate Valve Setting" in this issue points out the possibilities of saving coal by setting locomotive valves more carefully, particularly as relates to equalizing and squaring the cut-offs. There are three common methods of squaring valves on locomotives with outside valve gears, of which the first and simplest is to equalize the valve travels. In this method the crank arms are set approximately correctly by a gage and, with the portmarks scribed on the valve stems, the travels can be readily found by trailing the engine, adjustments being made to equalize them. The objection to this method is that no check is made of the important points of steam admission and cut-off. In the second and more common method the engine is put on rolls and the leads, or port openings at the dead centers, checked, being squared in the full gear. This method is the one more commonly used and gives reasonably satisfactory results, the main objection to it being that no attention is paid to points of cut-off. It is no more necessary that steam ports open at the same instant than that they stay open the same length of time. In fact, from the standpoint of fuel economy, the second consideration is the more important. The third method of squaring valves, therefore, takes into account the cut-offs and differs from the second method only in carrying it a step further. The reverse lever is "hooked up" to bring the cut-offs at about 25 per cent of the piston stroke and the engine is run over, measuring the piston travel at the points of cut-off. Adjustments are then made to equalize the cut-offs, front and back, right and left. It has been demonstrated that valve events do not occur in regular order and because the valves are square in the leads is no indication that they will be square in the cut-offs. It is explained in the article that unequal cut-offs cause fuel waste due to the fact that the locomotive must be operated with the reverse lever unnecessarily near the corner. This means a larger consumption of steam and consequently of coal as has been demonstrated not only theoretically but by practical tests as well. The possibilities and great need of fuel economy are such as to warrant the most careful attention to setting valves and especially as regards equalizing the cut-offs.

The Future of the Steam Locomotive

The papers to be presented before the Spring meeting of the American Society of Mechanical Engineers which are published in this issue are notable because they represent an attempt to outline in a comprehensive way the direction that future progess will, or should, take. When an attempt is made to look forward it seems that the growth in motive power during the past 20 years has been easy because it was attained principally by increasing the size of individual engines. This statement should not be construed to mean that there have not been notable refinements in design during that period. The history of locomotive construction records occasional examples of extremely heavy power that were built prematurely and proved a total failure. These isolated instances show clearly that changes from the former practices were necessary before a satisfactory design of large locomotive could be evolved. There have been remarkable improvements in design during the last two decades, yet the principal development has been in increasing the size of the power.

It is doubtful whether development of the locomotive can proceed much further along these lines. The cylinders on heavy engines have now reached the clearance limits and the boiler is as high as it can be made. Although locomotives with six pairs of coupled wheels have been built in Europe, it would seem that the rigid wheel base of five coupled pairs of wheels is the maximum that can be operated over curves on the majority of roads in this country.

This does not mean that further progress in locomotive development must stop. If the limit of size has been reached, designers still have it in their power to make locomotives more efficient by refinement in design. In the past the majority of American roads have adhered to locomotives of the simplest possible types. Now there is need for more critical attention to the details of the machinery. It may be necessary to sacrifice simplicity and deliberately adopt features that will increase maintenance costs in order to reduce the fuel consumption of the engines and increase their capacity. The true measure of the efficiency of the mechanical department is not in the cost of repairs per locomotive or per car, but in the overall expense of fuel, wages and repairs for handling passengers and freight.

Notable Innovation In Freight Car Design

The common type of freight car truck, carrying the load on the center bearing, is one of the oldest features of car construction in general use, having been first applied in 1831. The very fact that this design has been perpetuated so long is conclusive evidence that it possesses merit. The flexibility of the structure is well suited for uneven track and the equalizing system minimizes the stresses that are transmitted to the car body. The clearance at the side bearings permits operation over tracks that are not in a true plane without imposing twisting stresses on the body and the small radius of the center bearing permits the truck to follow curves with little pressure on the wheel flanges.

Few designers have attempted to depart from the basic principles outlined above. Some trucks have been built which carry the load on the side bearings, but all have retained the transverse bolster as an essential feature. The new 100-ton coal cars of the Norfolk & Western described in this

issue are noteworthy because of the fact that the load is carried on the side of the trucks and the center pin is used only to hold the truck in the proper position. By the use of longitudinal beams over the side frames the truck bolster is eliminated, being replaced by a light spider which holds the side frames square. This is especially noteworthy because six-wheel trucks usually require extremely heavy bolsters. The saving in weight by this method of supporting the load is not confined to the trucks. The body bolster likewise can be made lighter because instead of carrying the load to the center line, it is only necessary to carry it to the plane of the side frames, thus reducing the bending movement on this member materially.

Since the car is carried on four points of support, the question of the stresses set up when these points are not in the same plane becomes very important. The tests conducted on the first car built show that uneven track causes only slight variations in the load on each group of springs and does not result in excessive distortion of the car body.

Aside from the interest attached to the new design, the cars are notable for the high ratio of load to gross weight. Unnecessary dead weight in freight cars is costly to haul and light equipment offers opportunities for materially reducing operating expenses. The satisfactory performance of these cars since they were placed in service indicates that no unusual difficulties will be experienced in their operation or maintenance, and the results will fully justify the bold step which the mechanical department officers of the Norfolk & Western have taken in departing from conventional design.

An Old Friend

Probably the most familiar piece of machinery or equipment in railroad shops and roundhouses is the wheel lathe—familiar in many cases because the same old lathe has stood in the same place for so many years. Wheel lathes may be divided roughly into three groups, the first of which includes those not operated at all. Railroad men would probably be surprised to know the number of wheel lathes that simply occupy floor space (mostly in roundhouses) and never turn a tire. The second group includes wheel lathes which are operated but never ought to be. Perhaps they are underpowered and can hardly carry a one-quarter inch cut with one-eighth inch feed; sometimes their capacity is limited and large tires must be removed and turned on a boring mill, or shipped to another shop; in other cases the driving gears and mechanisms are so badly worn that the lathes cannot be operated even under medium cuts without seeming to tear themselves apart. The third group, to which fortunately a majority of wheel lathes belong, includes those modern productive machines which can, under average conditions, turn a pair of the largest tires in an hour or an hour and a half. Our point is that there are not enough machines of the third group in shops and roundhouses and that certainly there can be no excuse for longer retaining lathes in the first group.

It is said that the money for new wheel lathes is not available; also, that a roundhouse does not warrant the installation of a high priced special machine like a wheel lathe. Granting that in many cases the first statement is true and that the second holds for the smaller roundhouses, the only logical solution is to ship driving wheels to back shops where modern, productive wheel lathes are installed. Taking into account transportation charges and other elements, the tires will be turned quicker, better and cheaper. The examples of inefficient, worn-out wheel lathes are too numerous to mention and the only suitable place for obsolete and inefficient machines is the scrap heap.

New axle lathes also are needed badly in both roundhouses and repair shops. A great deal of credit is due to roundhouse and shop foremen for their ingenuity and determination in accomplishing results with inadequate equipment. At the same time the methods which they are sometimes compelled to use are very costly. The amount of waste effort on American railroads in a year due to the removal of tires for turning or pressing out axles to true up the journals is far too great. It is earnestly hoped in the present reorganization and attempt to place railroad finances on a firm basis once more that capital will be available to provide the shop machinery and equipment so badly needed for efficient, economical shop and roundhouse operation.

Apprenticeship in France

Elsewhere in this issue is an interesting article on apprenticeship as developed by the Paris-Orleans during the war. The principles which served as a basis for reorganizing apprentice courses are outlined in the article which explains the difficulties encountered and the results accomplished. The French have always realized the importance of training apprentices and workmen and in 1891 seven important railway systems had flourishing apprenticeship organizations. These systems differed in one essential. One group distributed the apprentices throughout the workshops and the other required their segregation in specially assigned buildings. These conditions continued from 1891 to 1900. On March 30, 1900, a law went into effect which forbade apprentices working in buildings where men were employed for more than ten hours a day. The effect of this law was practically to kill apprenticeship on some roads and to cause a notable falling off on others. At the beginning of the war, in spite of the high wages paid in ammunition factories and the consequent difficulty of securing apprentices, the Paris-Orleans reorganized its apprentice courses as explained in the article. Apprentice centers were formed in repair shops and roundhouses directly in opposition to the act of March 30, 1900, but the adoption of the eight-hour day in 1919 solved all difficulties in this connection.

The first principle of reorganization was recognized as the need for holding the interest of apprentices and paying them as much as possible by reducing the amount of unprofitable work to a minimum. The second principle developed was the importance of showing boys coming from a primary school just how and why practical work is done, as explained. An apprentice placed singly in a gang of workmen follows bad examples more quickly than good ones and in order that good habits of practice, discipline and self-reliance should be acquired, it was found best to group apprentices under the direction of capable instructors. One of the particular difficulties encountered was in the selection and training of these instructors. It was fairly easy to obtain good, practical workmen but they did not always have the mental requirements necessary for teachers. The recruiting of theoretical instructors also presented difficulties, perhaps the greatest trouble being to find instructors who would not confine themselves too closely to theoretical instructions difficult for the pupils to assimilate. The general conclusion seems to be that the quality and quantity of work performed by apprentices in the third year at least offsets their under-production in the first year and that the improvement of facilities for recruiting and developing capable shop employees and foremen is a clear profit.

It is interesting to note that apprenticeship centers are maintained at important roundhouses in France to afford preliminary training for engine drivers. In this way a man becomes a mechanic before he is a fireman or engine driver and the result is that most French enginemen are of mature years, thoroughly familiar with the detailed construction of practically all locomotive parts and are therefore able to give them the most intelligent and careful attention. French railroad men as a whole were astounded at the comparative youth of Americans assigned to drive the heavy American

Consolidation locomotives sent to France with the A. E. F. While these locomotives hauled an immense amount of traffic without serious accident, the American engine drivers could undoubtedly have taken lessons from their older French brothers in fuel economy and getting mileage between shoppings.

NEW BOOKS

Cams, Elementary and Advanced. By Frank De Ronde Furman, 224 pages, 6 in. by 9 in., bound in cloth. Published by John Wiley & Sons, Inc., New York City.

The chief original features of this book include the development and use of logarithmic, cube, circular, tangential and involute base curves, the establishing of cam factors and the demonstration that the logarithmic base curve gives the smallest possible cam for given data. The material given includes also the comparisons of the characteristic results obtained from all base curves in which the relative size of each cam, and the relative velocity and acceleration produced by each, is shown graphically in one combined group of illustrations. This enables the designer to glance over the entire field of theoretical cam design and quickly select the type that is best adapted for the work in hand. From these diagrams it is possible to note which form of cam is best adapted for gravity, spring or positive return, which is best for fast or slow velocities at various points in the stroke and which ones are apt to develop "hard spots" in running. Cam constructions best suited for heavy work in one or both directions are also described. All of the material is fully and clearly presented, the processes of design being mostly graphical and readily followed by practical shop men and draftsmen as well as by technical students.

Simple Superheated Steam Locomotives (Heissdampf Lokomotiven mit Einfacher Dehnung des Dampfes). By Eugene Brückmann. 600 pages, 11 plates, 7½ in. by 10½ in., illustrated. Bound in cloth. Published by C. W. Kreidel, Berlin, W. 9, Germany.

This volume is the third edition of a book which forms part of a cyclopedia on railroad practice. Being restricted to the most important type of motive power in use today, it covers the field comprehensively, treating the subject historically as well as on the basis of present practice.

The book opens with a history of superheated steam locomotives and describes many old patents as well as notable constructions of more recent date. A short chapter is devoted to the qualities of superheated steam, and this is followed by an analysis of the possible saving in water and fuel by the application of superheat. The increase of tractive effort at the drawbar and at the tender is analyzed for various pressures, for high and low speeds, compared with dry steam and with steam containing 20 per cent water. The limitations of steam pressure and superheat are also discussed.

The chapters on the locomotive boiler discuss the production of superheated steam, combustion in the locomotive and the theory of the locomotive boiler and superheater. The general discussion is followed by the computation of a saturated and a superheated steam boiler for the comparison of their performance and capacity. Rules for the calculation of boilers are given and materials for the construction of superheaters are discussed. The section on the types of construction and development of superheaters is very complete. A chapter is devoted to the calculation of the details of machinery for superheated locomotives which is followed by a discussion of the development of the superheated steam locomotive, instructions for handling locomotives in service, and descriptions of some of the newest types constructed. Tabulations of dimensions and drawings showing the general design complete the volume.

COMMUNICATIONS

Are American Roads Prejudiced Against Compounds?

HEATH, MASS.

TO THE EDITOR:

It would be interesting to know the number of compound locomotives, exclusive of Mallets, still operated by railroads in this country and the results obtained. Many railroad men would no doubt feel that such information would be of no interest as the utility of compounds in the United States is definitely settled. Is this not largely a matter of prejudice? We read now and then of cross-compounds converted into superheated simple engines and of the economies effected, but why not retain the compound arrangement and add superheat as has been done successfully in Europe as well as in the case of American Mallets? Some statements regarding compound locomotives give the impression that intercepting valves are difficult to maintain. This argument does not appear sound for in the last decade devices have been added to the locomotive which require as much, if not more, attention than an intercepting valve.

An analogy in prejudice may be cited in marine engineering. Many of the latest ships will be found to be without superheaters and yet the idea of a marine engineer building a non-compound engine would be considered as absurd as building a large locomotive without a superheater.

In view of the success of Mallets in such cases, it is strange that economy cannot be effected by the use of compounds on divisions of a suitable nature.

W. G. LANDON.

RIGHT KIND OF FOREMEN'S COURSES.—American business is finding it profitable to train plant foremen in the elements of good foremanship. Courses of instruction, conducted in the plants and designed to train foremen to cope with the problems that present themselves each working day, not only are developing better foremen, but are bringing returns in the form of increased morale, lower labor turnover, reduced costs and greater production.

The purpose of foremanship training, says an authority on the subject in *Forbes Magazine* (N. Y.), is to increase production and decrease costs. It is easily understood that those two things naturally follow when foremen are developed into real leaders and man handlers, thoroughly conversant and proficient in all phases of their jobs. A well organized course, therefore, will have these general functions:

1. To view the foremanship job in the perspective.
2. To analyze its responsibilities.
3. To develop intelligent performance of these responsibilities.
4. To develop team work.
5. To develop correct interpretation of policies.
6. To develop constructive thinking.
7. To develop analytical ability.
8. To develop leadership and subordinate driving methods.

The course itself, he adds, must be planned specifically around the first four items. The rest is more or less the general result of the discussions and follow up. Any foremanship course that performs these functions, even to a limited degree, is serving its purpose.

LOCOMOTIVE BUILDING IN FRANCE.—The French output of locomotives at the end of the year 1922 will be 1,300 per annum. As its normal home consumption will not be more than 600, France will, states the Times (London) Commercial Supplement, become an important rival in foreign countries.

Problems in Design and Operation of Large Locomotives

Necessity for Improvement to Secure Maximum Service, Reduced Maintenance Costs and Increased Earning Power To Be Discussed at Railroad Section of A. S. M. E.

THE design and operation of large locomotives is the general subject which will be discussed at the railroad session of the Spring meeting of the American Society of Mechanical Engineers, to be held at the Congress Hotel, Chicago, May 26, 1921. Three papers, each covering a different phase of the question, are to be presented. The detailed design of large locomotives will be treated by M. H. Haig, mechanical engineer of the Atchison, Topeka & Santa Fe. H. W. Snyder, mechanical engineer of the Lima Locomotive Works, will have a paper on the Necessity for Improvement in the Design and Operation of Present Day Locomotives, while the need for the 2-10-2 and other heavy freight locomotives for road service will be discussed by A. F. Stuebing, managing editor of the *Railway Mechanical Engineer*. Abstracts of the papers by Mr. Haig and Mr. Snyder are given below. The third paper will be published in the June issue.

The Design of Large Locomotives

BY M. H. HAIG

Mechanical Engineer, Atchison, Topeka & Santa Fe

THE design of a large locomotive depends on the service to which it is to be assigned. The service varies with the weight of the train to be hauled and the number of cars in the train, and is affected by the topography of territory on which it is to operate, ruling grades in each direction, length of grades, average speed between terminals, method of dispatching, whether single or double track between terminals, etc. This information being available, it is a reasonably simple matter to determine upon the leading features of a locomotive to meet the requirements.

Restrictions and Limitations Imposed

For a locomotive to give practically 100 per cent service, its design and construction must not be restricted by personal opinion or by physical limitations of the road. If the weight needed for adhesion in starting a given train is restricted by an opinion that certain wheel loads should not be exceeded or because bridges and track are not capable of carrying the necessary weight, then the capacity of the locomotive is restricted and the train must be adjusted to the locomotive, instead of the locomotive being built to suit the train. This in turn has a tendency to limit a division or a railroad as a whole. Limitations such as these, together with clearances of bridges and structures, obstructions along the right of way, etc., affect the locomotive design and construction. The locomotive as a whole is dwarfed, or some of its vital or essential parts are so dwarfed as to cripple the machine as a whole.

A railroad is a plant, establishment or organization for manufacturing transportation. The locomotive is a very important part of the plant and is one of the most direct earners of revenue from which the transportation-manufacturing plant obtains its income. As such, it is a matter of business and economical principle to adjust some of the physical conditions of the road to meet the requirements of the locomotive, to prevent dwarfing it and to prevent sacrificing its power. Meeting these requirements of the locomotive amounts to meeting the necessary requirements of traffic. No turntable installed at a principal roundhouse should be less than 100 ft. long, and in many cases the length should be 125 ft. The distance between the walls of a modern roundhouse should be great enough to permit closing the door behind the tender of a Santa Fe or Mikado type locomotive and have ample room for trucking between the locomotive pilot and the outer wall of the roundhouse. Passing tracks should be long enough to take trains justified by the business and traffic of the division or territory. Bridges, rail and roadbed should be capable of carrying a static wheel load of at least 65,000 lb. per pair and of permitting the additional stresses resulting from a freight speed of at least 45 miles per hour. In meeting the requirements of rail stresses particular attention should be given to the employment of heavy rails on curves.

Unless these physical conditions are provided, a locomotive cannot be designed and constructed without restriction and proper power cannot be furnished to meet requirements. The only governing factors should be the size of train and the traffic of the territory.

Leading Features of Locomotive Construction

Leading features of locomotive construction such as relative size of cylinders, length of stroke, total heating surface, superheating surface, grate area, etc., have been well covered by handbooks and pamphlets issued by locomotive builders and by reports to the various associations, as well as by articles in the technical press. Tables of principal dimensions of large locomotives are obtainable from the same sources, together with detailed descriptions of features of design and construction which have met with general favor and some which have been short-lived. A discussion or comment on these features would therefore be largely a repetition of facts already presented and easily available.

Features which have not been so generally discussed and exploited are those which keep a locomotive in service a maximum length of time, reduce engine failures to a minimum, reduce cost of maintenance and repairs, and increase revenue-earning power. Among these, durability of material and accessibility of parts are important factors. The latter implies arrangements by which a locomotive is made free from complications in construction, inexpensive to repair, easy to maintain, and so put together that needed repairs can be made handily and quickly.

Almost as important as providing a locomotive that will meet the requirements of trains to be hauled and traffic conditions, is providing one that requires minimum repairs—a locomotive that after one trip is ready to be turned for the next trip.

A locomotive is in revenue-earning service only when it is hauling trains. Any road can make a study and determine what proportion of its locomotives are unserviceable and what percentage of the time its serviceable locomotives are on the road. Such information will show what percentage of the time its engines are earning revenue.

To maintain the advantages of designs already existing and to develop these still further requires the unlimited co-operation not only of the mechanical, civil-engineering and operating forces of the railroads, but also of the locomotive builders, and particularly of the manufacturers of material.

The necessity for unlimited co-operation by manufacturers

of material is evident from the study of failures of parts both large and small. On the principle of encouraging further consideration of such co-operation by all concerned and for the purpose of arousing interest in those details of locomotive construction which are not always given the attention to which they are entitled, a number of details which seldom appear among "leading dimensions" will be discussed.

Counterbalance

Important among such details and one which is affected particularly by designers and manufacturers of material, is the counterbalance. The blow from the counterbalance is caused by the difference between the weight of the revolving parts carried by the pins and the total weight in the wheel to balance both the revolving and reciprocating weights. In other words, it is the weight in the wheel to balance reciprocating weight that causes the hammer blow.

Weight of reciprocating parts therefore affects hammer blow of driving wheels, riding qualities of locomotives, possible damage to track and bridges and total weight of locomotive. It is particularly essential to make these parts as light as possible, and to make them light the material must be durable.

Due to the increase in weight of locomotives and to the hammer blow on rails when reciprocating parts are heavy, the 1915 Committee of the American Railway Master Mechanics' Association made the following recommendation:

> Keep total weight of reciprocating parts on each side of locomotive below $^1/_{100}$ part of total weight of locomotive in working order and then balance ½ weight of reciprocating parts.

An attempt to counterbalance large locomotives in both freight and passenger service according to this recommendation has demonstrated its merit, but has further demonstrated that the durability of both cast and forged steel must be improved if the method is to be continued.

Crossheads

The Laird type of crosshead is lighter than several other designs, its performance is very satisfactory in service, and

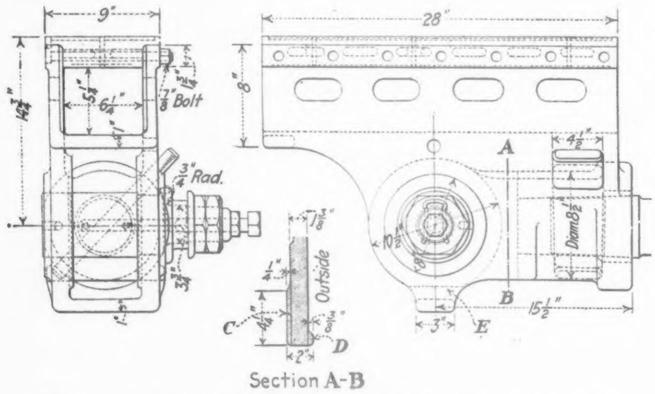

Fig. 1—Laird Crosshead Used on Various Types of Large Locomotives

it therefore has advantages in designing for light reciprocating parts. A crosshead of this type used interchangeably on large freight and passenger locomotives is shown in Fig. 1.

The construction originally employed is shown by the figure, with the exception of later reinforcement at *C, D* and *E*. After about a year's service these crossheads began to break, the weakness appearing in the relatively thin wall between the hub around the piston rod and the lighter hub around the crosshead pin. The same weakness developed in crossheads of similar general design among locomotives of three or four different classes. The defects which proved common to these different crossheads are shown in Fig. 2.

By breaking up these crossheads in order to investigate the nature of the metal, it was found that in most cases each fracture had its origin in a shrinkage crack. The metal in most of the broken crossheads was found to be porous and to contain blowholes or gas holes, or shrinkage cracks, cold shuts or pipes. In some cases all of these defects were present.

Fig. 2 shows very clearly the difference in cross-section of the metal at and near the break. This difference is no doubt largely responsible for the defects in the metal which have caused an epidemic of failures. Crossheads of this general design have been used for many years, and as it appears impossible to modify the shape to advantage, the question, then, is whether foundries can adjust their practices to cast

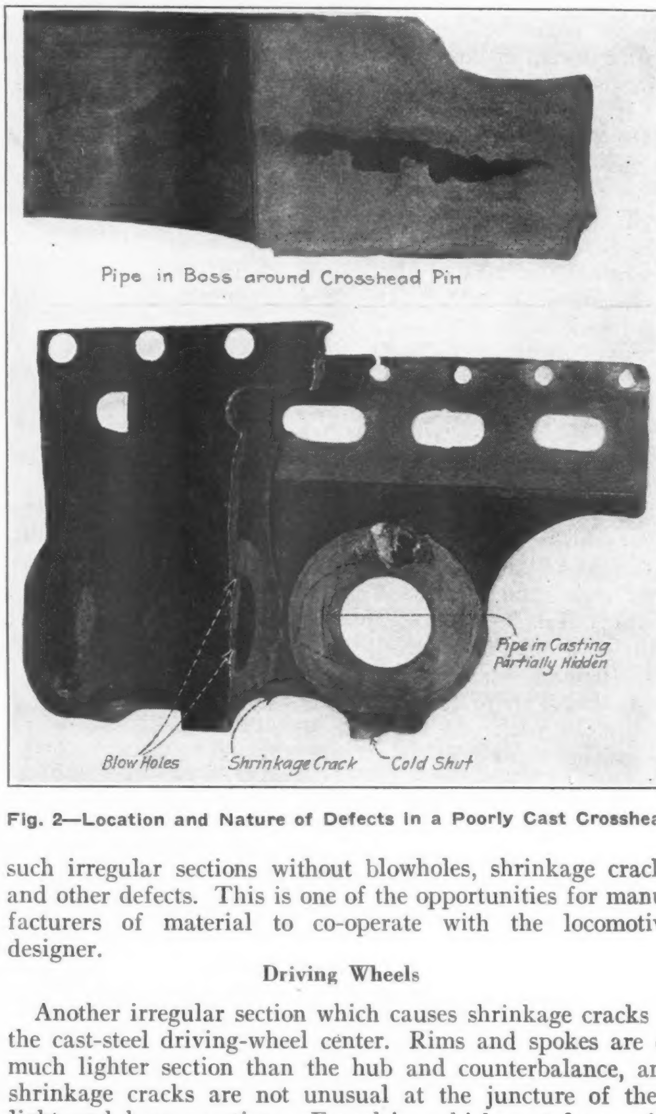

Fig. 2—Location and Nature of Defects in a Poorly Cast Crosshead

such irregular sections without blowholes, shrinkage cracks and other defects. This is one of the opportunities for manufacturers of material to co-operate with the locomotive designer.

Driving Wheels

Another irregular section which causes shrinkage cracks is the cast-steel driving-wheel center. Rims and spokes are of much lighter section than the hub and counterbalance, and shrinkage cracks are not unusual at the juncture of these light and heavy sections. Foundries which cast locomotive parts have these conditions to meet and it is believed that foundry practices can be adjusted to meet them.

Crosshead Pins

In the development of locomotive construction within recent years the union link of outside valve gears has been connected direct to the crosshead pin. This reduces weight by eliminating the crosshead arm and by shortening the length of the combination lever, thus lessening reciprocating as well as total weight. A further advantage is in eliminating the bolted connection between the crosshead and arm.

In eliminating the crosshead arm the duty of the crosshead pin is increased. A broken crosshead pin is more serious than a broken crosshead arm. When a pin breaks there is a possibility of something else being broken and a very great proba-

bility of a cylinder head being knocked out and carrying a part of the cylinder wall with it. It is therefore absolutely necessary that the material in the crosshead pin shall be of a good quality, and the steel used should contain about 0.50 per cent carbon and have a tensile strength of 80,000 lb. per sq. in.

By reference to Fig. 1 it will be observed that the diameter of the union link shank of the crosshead pin is 3¾ in. This is believed to be considerably larger than usual in locomotive design. Even though the stresses in the crosshead pin are low, this large size appears to be a necessary precaution against the uncertainty in quality of material. As a further precaution there is a fillet of ¾-in. radius at the end of the shank.

Piston Rods

The greater number of breaks in piston rods of at least one railroad have been through the keyway. Next in order is the location in the crosshead fit adjacent to the collar. Breaks in the body are usually adjacent to the collar at the crosshead fit and occasionally at the collar adjacent to the piston-head fit.

The mechanical fit between the rod and the crosshead is often responsible for the breakage of the former. If there is not a good bearing throughout the length of the fit or at both ends of it, there is opportunity for a slight movement of the rod in the crosshead. This starts a crack which gradually progresses into a fracture. To facilitate making a good bearing at both ends of a piston-rod fit in a crosshead, the diameter is reduced 1/16 in. for a length a little greater than the keyway and about midway between ends of the fit. To prevent cracks starting in sharp corners at edges of the keyway, these edges are chamfered at both ends of the keyway and entirely around.

Rods with comparatively low stresses sometimes fail in such a manner that it is difficult to attribute a cause unless quality of material is responsible. This is true of rods of ordinary carbon steel as well as those of specially refined steel and of alloy steels. In this is another opportunity for the assistance and co-operation of manufacturers of material.

Cylinders

Failures of parts such as those described in preceding paragraphs, quality of material, uncertainty of cylinder cocks being operated, extreme variation in temperature due to use of superheated steam, foundry practices, etc., all affect the design of cylinders. Consideration of these and other features has resulted in the development of the design shown in Fig. 3, which is that of the cylinder of a Mikado locomotive. Except for modifications in dimensions this represents cylinders used also on Santa Fe, Mountain, Pacific and other locomotive types. The principal features of this cylinder are:

Simplicity in construction.
Uniform thickness of metal.
Absence of heavy metal sections at junctions of walls.
Walls and parts of ample thickness for strength, well ribbed, well braced and arranged with easy curves and generous fillets.
Uniform sectional area throughout length of steam and exhaust passages.
Short steam ports.
Small steam clearance.
Sections of metal, fillets and other features arranged to eliminate internal stresses set up in metal when cooling.
Double row of splice bolts holding halves of cylinder saddle together.
Double row of bolts at smoke arch.
Triple row of horizontal bolts securing cylinder casting to frame.
Depth of saddle casting directly above frame forming a box section and providing strength where shallow castings used with double-frame rail failed in the past.
Location of valve close to cylinder, permitting short ports, straight valve gear without offsets, and application of nearly straight steam pipe.
Large openings to cylinder cocks.

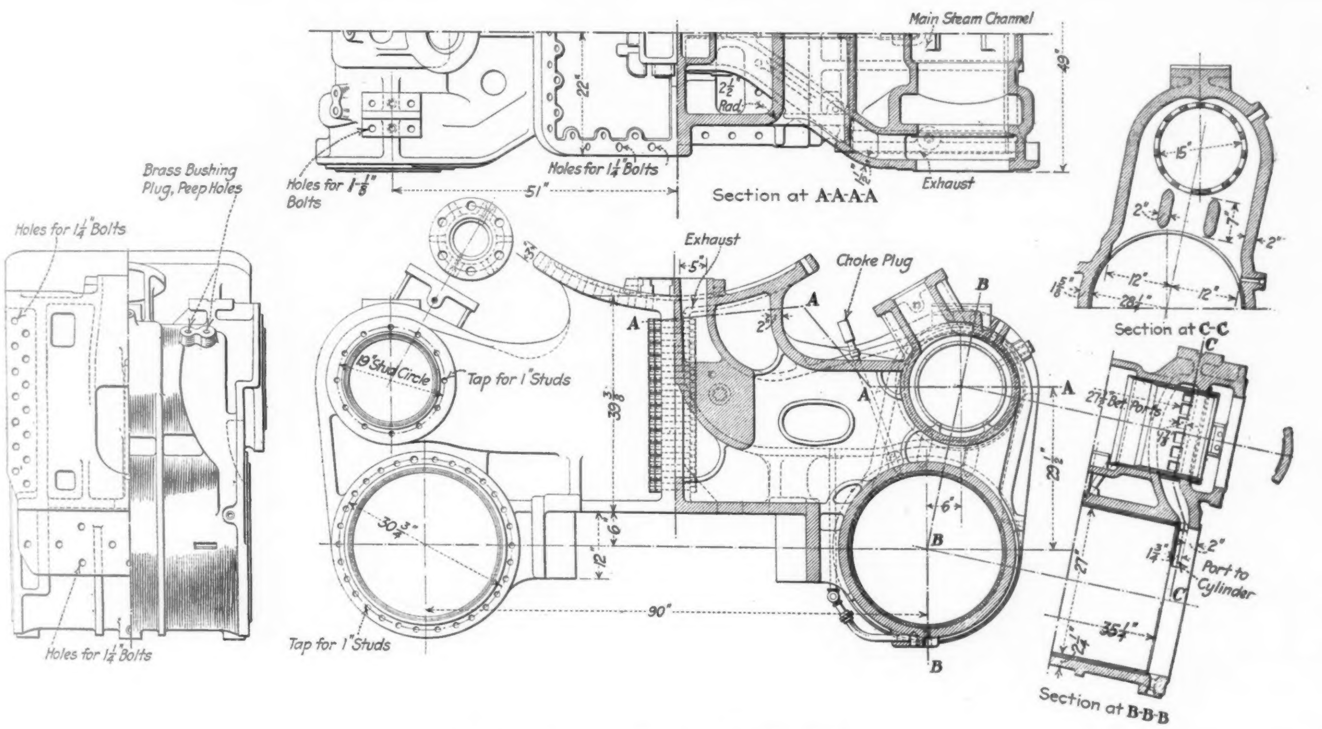

Fig. 3—Cylinder for Large Locomotive

The steam and exhaust channels are free from obstructions and restrictions which will interfere with free flow of steam. The exhaust channels are gradually reduced in area from valve bushing to base of exhaust pipe in such a manner that the cross-sectional area of any point in the channel is not larger than any area through which exhaust steam has previously passed.

A weakness in castings of some large cylinders has been in the wall around the live-steam port. As shown in Fig. 3, this wall is made 2 in. thick and the distance across the port below the valve bushing is 24 in. To reduce stresses in this wall it has been made thicker than most other walls of the casting and, compared with former practice, width across port has been reduced about 4 in. The bridges in the live-

steam port are 2 in. thick. They were formerly but 1 in. in thickness and it was not unusual to find them cracked clear through. The change was made to increase the cross-section of the bridges in relation to the adjacent walls and thereby reduce tendency to shrinkage cracks.

To obtain a good cylinder casting from any design, it is necessary to have proper co-operation of the pattern shop and the foundry. Patterns must be well built and carefully checked. The checker should exercise especial care to see that patternmakers apply all the fillets called for. The foundry should so arrange the mold as to obtain uniform sections of metal. To insure this, careful measurements should be taken when cores are being set and a drop light should be let down into the mold when taking measurements.

Frame Braces

Locomotive frames are subjected to repeated lateral and twisting stresses, as well as to various other stresses, which will gradually break a single frame, but which can be withstood indefinitely by the application of substantial braces. An example of a pair of strong frames substantially braced is shown in Fig. 4, the arrangement illustrated being for a Santa Fe type locomotive. Bracing in the manner shown has been used for a number of years very successfully, and with very little modification is applicable to any locomotive class with outside valve gear.

Braces must be bolted to frames securely. Where braces or castings of other parts are bolted to a frame, the bolts should be applied with the head end bearing in these parts and not the thread end. This will provide for bearing on the bolt through the full thickness of the part bolted to the frame.

Boiler Cracks

In using the boiler to supplement the frames in forming a backbone or foundation from which to brace machinery parts, the boiler shell is subjected to additional stresses which result in cracks in the sheets. The most frequent causes of these cracks are guide-yoke braces, valve-motion braces and the ordinary belly braces to frames. Guide-yoke and valve-motion braces are often very stiff and are bolted securely to the frames and studded to the boiler. When the boiler expands the braces and connections are held rigidly by the frame and there is a tendency for the boiler to tear itself loose from these fastenings. This sets up strains in the metal which are aggravated by the vibration and pounding to which braces are subjected.

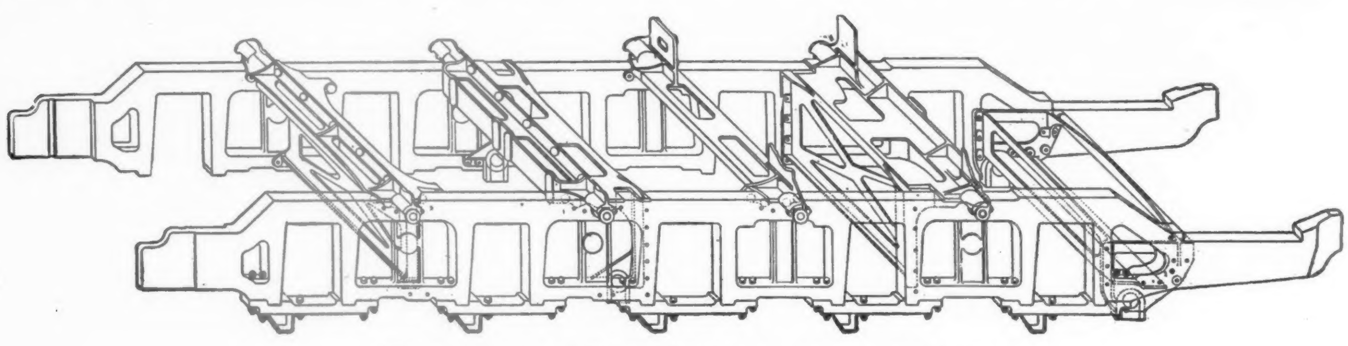

Fig. 4—Frames and Frame Bracing of a Large Locomotive

In an effort to overcome these cracks, outside welt plates have been riveted to the boiler to reinforce it where the brace pads are studded on. Experiments have been made with flexible, or partially flexible, braces, some of which have so far been successful.

On engines where breakage of braces has occurred, some of them are being replaced by braces with a pin connection at the lower as well as upper end. Where the use of pins is not favored, however, a thin plate in connection with a cast-steel brace should provide sufficient flexibility for expansion of the boiler and proper stiffness for bracing machinery parts.

The Back Flue Sheet

Boiler back flue sheets of large locomotives are renewed and patched more frequently on account of cracks in the knuckle near the top flange than from any other cause. On at least one road the average life of flue-sheet knuckles is three years and three months, the maximum and minimum varying within rather a large range.

A minimum limit of distance of top flue holes from top

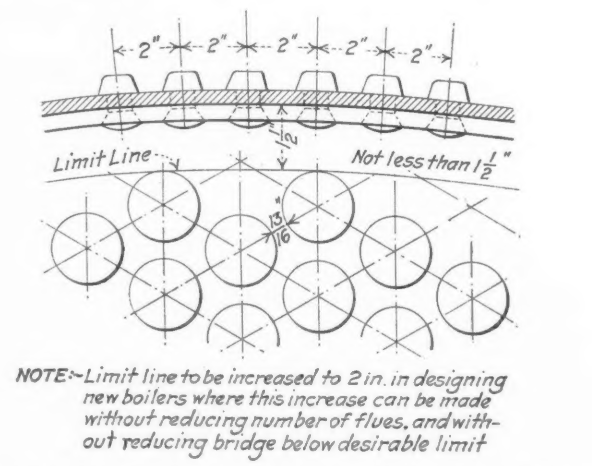

Fig. 5—Minimum Distance Between Top Row of Flues and Flange of Back Flue Sheet

of flue sheet that is considered practical is shown in Fig. 5 To omit flues near the top of the flue sheet sacrifices heating surface. To raise the top of the flue sheet above the usual location of flues increases the weight in the firebox, adds to the amount of water necessary to cover the crown sheet, and by requiring increase in diameter of boiler to maintain steam space above the crown sheet, increases the weight of the boiler and consequently the weight of the locomotive as a whole.

Considering the stresses and the peculiar punishment to which flue-sheet knuckles are subjected, it is important to specify this material carefully. The following limits have been demonstrated by experience as practical:

Tensile strength, 52,000 to 60,000 lb. per sq. in.
Elongation, not less than 25 per cent.
Carbon, 0.12 to 0.25 per cent.
Sulphur, not over 0.025 per cent.

The Ashpan

Various details at the rear of a locomotive should be arranged to permit a large ashpan with smooth slope sheets at an angle that will permit cinders to fall to the hopper without obstruction, and its design should be decided on before the designs of surrounding parts have progressed too far. Equally as important is area between the ashpan and mud ring or

through parts of the pan, to admit air to support combustion. This area should be at least equal to the area through the boiler flues, and preferably a little greater.

The Grate Rigging

The place for grate rods, which operate the grates, is near the center of the grates and above the deep portion of the ashpan. On locomotives without stokers this arrangement is not difficult to provide for. With some stokers, however, grate rods in this position are interfered with, and this has resulted in some grate rods being located along the sides of pans, in certain cases very close to the flat portion or shelf of the pan under the mud ring. In this position the rods collect cinders close to the air openings and obstruct the admission of air for combustion. With steam grate-shaker equipment and stoker the grate rods can be located near the center of grates by applying a set of intermediate rockers.

Water Columns

A very thorough investigation into conditions affecting the performance of water columns indicates that the most satisfactory service is obtained with a column and connections conforming with the following specifications:

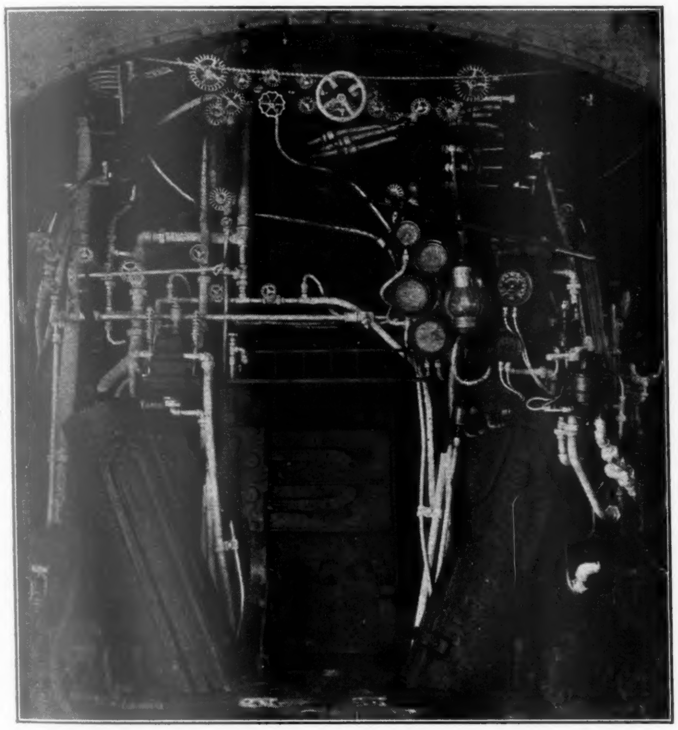

Fig. 6—Location of Boiler Back Head Fixtures in Large Locomotive

Inside diameter of water column, 3½ in.
Inside diameter of top steam pipe, 2 in.
Inside diameter of connection of column to top steam pipe, not less than 2 in.
Inside diameter of bottom connection to boiler, ¾ in.
Top steam pipe as short as possible consistent with required location forward of boiler back head flange.
Minimum number of bends in top steam pipe to column. This pipe to be lagged.
No valves between water column and boiler either in top steam pipe or in bottom connection.
Water-column bottom connection should extend into boiler far enough to clear nearby T-irons or other obstructions, approximately 4½ in. from inside of sheet.

Cab Equipment

The back wall of the cab should be far enough away from the boiler back head to give room for a satisfactory seat, for the application of the required equipment, and for a man to pull the throttle open without striking his arm against it. A distance of 46 in. from the face of back head at the center of fire door to the back wall of cab will meet these requirements.

Engineers' and firemen's seats should be located where the men can see ahead and their vision should not be obstructed by air pumps located too high, classification lamps misplaced, running boards too high at the front, or other obstructions that might interfere with their seeing semaphores, switch stands, etc.

Blow-off cock handles should be so located that they can be operated by a man in position where he can see the water glass, and preferably without leaving his seat. The water glass, steam gage, air gages, etc., should be so located that they can be seen by the engineer when in usual position on his seat.

The throttle lever, power reverse lever, cylinder-cock lever, sander valves, brake valves, etc., should be located where the engineer can reach them handily when sitting in usual position on his seat or sitting with his head out of the window. It appears like a small detail, but it is a worth-while one to locate the straight air valve where it can be reached easily by an engineer when in such a position that he can see a man at the back of the tank giving signals for coupling to a train.

The lubricator must be at such a height that a man can see the feeds, and it must be high enough to avoid pockets in the oil pipes. It must be far enough below the cab roof to be filled easily.

Cab equipment requires careful study and it is difficult to locate the various appliances by drawing, but it has been done. A cab with a large amount of equipment on the boiler back head, yet which is regarded as being reasonably convenient, is shown in Fig. 6.

The use of clear-vision windows has made it somewhat difficult to arrange the seats so that either seat or window will be a height to suit different men. This problem, however, has been solved for one road by its motive-power department chief, who has developed an adjustable seat made of steel and having a spring cushion and an upholstered back. The back being secured to the seat and independent of the back of the cab prevents any vibrations resulting from shaking of the cab wall.

Tender Capacity

Tender capacity should be arranged so as to reduce to a minimum the time a locomotive is detained from the productive work of hauling trains for the purpose of taking water and fuel. This implies large fuel and water capacities, but in arranging for suitable tender capacity care must be taken to avoid unnecessary weight, as any increase in the weight of the tender produces an equal decrease in the weight of train that can be hauled behind the tender.

Tender fuel space should be arranged so as to enable the locomotive to handle a full train with as few stops for fuel as may be feasible.

On territories equipped for water to be taken on the run or when stops for purposes other than taking fuel or water are made regularly at stations where water may be taken, the water capacity should be only sufficient to supply the locomotive when handling a full train, between water stations, with a moderate surplus for unusual delays.

On territories handling a large percentage of through trains with few stops, tenders of large capacity are desirable as they permit keeping locomotives more continuously at work. Where water is scarce and the supply has to be hauled to water tanks, tenders of large capacity are desirable as they reduce the number of water stations that must be maintained as well as the number of locomotives, cars, and men employed in hauling and handling water at these stations.

In addition to reducing time consumed by trains on the road, together with overtime pay to train and engine crews, large-capacity tenders effect a substantial saving by reducing the fuel consumed in starting and accelerating trains as well as the damage to locomotive machinery, draft rigging, tires and rail which frequently results from stopping and starting

long freight trains. Train dispatching is simplified and the movements of superior and opposing trains are expedited, as a train which keeps moving interferes less with the movements of other trains than one which must stop frequently, thereby introducing uncertainty as to how long it will be detained.

Necessity for Improvement in the Design and Operation of Present-Day Locomotives

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Mechanical Engineer, Lima Locomotive Works

No one, it is believed, will dispute the fact that present-day operation of high-power locomotives is one of the most vital questions with which our railroads are concerned. The demands of constantly increasing passenger and freight traffic have brought about a constant increase in size and power of our locomotives.

In view of the rapid strides that have taken place in increasing the size and power of locomotives within the last few years, it seems rather out of place to predict that the maximum has been reached. It is also true that the use of improved devices has made possible the satisfactory operation of the large locomotives of today. Everything seems to indicate that we have not reached the maximum capacity of the locomotive even within the present limits of clearance and rail load, and we may expect to see these same engines made far more powerful and economical by the application of devices which are now available or which are already being given serious attention.

In view of the foregoing, the most vital matter which confronts locomotive designers and operating officials is that of increasing the capacity as well as the efficiency of the locomotives which we have today. In many ways these problems have already been attacked and great improvements are continually being made.

In the following paragraphs an attempt will be made to bring to attention some of the problems which our present day locomotives bring forth and upon the proper solution of which depends their success.

Combustion and Steam Generation

In order that large engines may operate properly, it is of course necessary that a sufficient supply of steam be furnished to cylinders so that they can be made to produce their maximum horsepower. It is not enough to provide a given number of square feet of heating surface in the firebox and the tubes so that we may be reasonably certain that sufficient water will be evaporated to supply the cylinders. It is, however, necessary that we take into account proper construction of the boiler, necessary firebox volume to produce the best possible combustion of fuel, and the design of grates so that fuel will be economically burned to such an extent only as required by the maximum evaporation of the boiler.

In producing heavy motive power it has been necessary on account of prohibitive axle loads to apply a sufficient number of axles under the engine to reduce the individual axle load to within reasonable limitations. This has lengthened out the engine to such an extent that boiler design and maintenance has become a serious problem. In the first place, it is necessary to design a boiler that will properly function with the other vital parts of a locomotive. At the same time the length has become such that the use of combustion chambers is a necessity to avoid a prohibitive length of tube. Large engines have been constructed with a tube length of 25 ft. and it seems that no definite rule has been established as to what the limit of length of tube of a given size should be. Experiments have been made on this subject and it has been said that the maximum length in inches of a tube of a given size should be approximately 100 times its diameter in inches. It would seem that this is as nearly correct as any general rule which has been devised and one which can be readily followed.

The author does not feel that any definite rule should be made in regard to length of tubes, for this might bring about a condition whereby other vital features of the engine would be involved in order to abide strictly to the length as noted above. Tubes 2 or 2¼ in. in diameter in excess of 20 ft. in length are questionable, and this feature should be looked into carefully before a decision is reached.

The advent of long combustion chambers has brought along with it the necessity for increased attention to boilers. The application of a long combustion chamber requires a large number of additional staybolts and it would naturally be expected that a boiler of this kind would require more staybolt attention. For this reason, if for nothing else, there is no doubt that a proper installation of flexible stays in the firebox and combustion chamber will prevent a great deal of the staybolt trouble which has been experienced in the past. Although long combustion chambers require more attention in maintenance this will be offset by the increased firebox volume and the resulting better combustion.

On account of height limitations, the height of the dome as well as the steam space in the boiler has been reduced to such an extent that difficulties are being encountered with the proper life and maintenance of superheater equipment, because too much water is drawn over through the throttle into the superheater. This is a question requiring experiment to determine as nearly as possible the minimum steam space which should be provided for boilers working on various grades. Consideration should also be given to the height of the throttle above the water line as well as to the steam space in the boiler. Considerable development on this subject is now well under way and we can confidently expect results of value in the near future.

Increased Capacity Needed Without Increase in Size

As noted above, it seems that we have about reached the limit of size of cylinders and size of boiler due to road clearances. To undertake to provide additional road clearance on practically all of the main lines today would mean a total expenditure of money, entirely out of proportion to the benefits that would accrue.

On account of the apparent limitations of piston thrust and road clearances the greatest problem with large locomotives today is to increase their capacity without exceeding greatly present sizes. Anything to increase the hauling capacity of the locomotive without increasing the height and width limitations under which the locomotive must work might be called an essential capacity-increasing device. A few of these with which we are most familiar and which have proved beyond doubt their desirability are the superheater, the brick arch and the mechanical stoker. There are possibilities of still increasing the efficiency of the superheater without increasing the size of the boiler in which it must operate. There are also possibilities and constant improvements in the design of brick arches which lend to higher evaporation and better combustion of fuel. It has been stated that when a locomotive requires as much as 6,000 lb. of coal per hour it has gone beyond the limits of the ordinary fireman. Automatic stokers have been in use so long that their dependability for heavy power is no longer in question. Many men are studying this particular feature of locomotive design and operation and we may confidently expect in the future a gradual increase in the efficiency of these mechanisms. As they stand today they are an unqualified success, and time and study will bring about the necessary refinements so that better combustion and less coal per horsepower will be used.

We have not as yet gone very extensively into the use of feedwater heaters. It has been proved without a doubt in foreign countries that the feedwater heater is an essential capacity-increasing device as well as an economical addition to the locomotive. In this respect, then, it would seem that we are somewhat behind the Europeans, and there is no doubt that in the near future when the economies that can be effected by the use of feedwater heater are realized it will become almost as general as the superheater today.

Another small item which has received only passing attention in this country is the variable exhaust. As is well known, a variable exhaust that can be properly operated and which will not require much maintenance attention will have a great tendency to relieve high back pressure at high speeds, and its operation will also provide the necessary draft at slow speeds. It is one of the small things that deserves consideration and study and something which it is felt will be worked out satisfactorily for the future.

The Engine Proper

There have been no radical changes in the general design of cylinders. The use of outside steam pipes has resulted in advantages both from a casting and maintenance standpoint. It would seem well worth while to consider a design of cylinder by means of which the weight could be reduced to a great extent, permitting of additional weight of other parts, and thereby increasing the capacity of the locomotive.

The design of valve gears has received a great amount of attention and many accepted types are now available. In all of these every effort has been to better the steam distribution. In maintenance we are far ahead of engines used twenty years ago. There is yet, however, much to be desired in steam-distribution and this subject will bear as careful study in the future as it has in the past.

Power Transmission

When we consider that as much as 150,000 lb. piston thrust is being transferred through a single main rod and from this into the driving wheels of a locomotive, it is not difficult to understand why troubles are experienced with main crankpins and particularly side rod bearings at the main pin. In order to provide the proper strength to take care of this tremendous piston thrust it has been necessary to design extremely heavy main and side rods. The piston thrust is not the only consideration in this connection. The inertia forces, particularly in drifting, at times reach figures that are even greater than the piston thrust. Practically all of this must be taken care of through the main crank pin and the necessary connections to the side rods at this point.

All are familiar with the large number of experiments which have been carried on to produce a steel that would give a higher elastic limit than the ordinary high-carbon open-hearth steel which was successfully used until engines reached their present proportions. The use of such steel for side rods, main rods and piston rods has been principally confined to heat-treated and quenched forgings, which permitted the use of sections which were considerably lighter than what could be used with the ordinary open-hearth annealed forgings. Steel has also been produced which gives a high elastic limit and which can be successfully used with ordinary annealing, permitting very considerable reductions in weight compared to the ordinary open-hearth steel formerly employed. The use of such a steel does away with quenched forgings and permits of rods being heated for closing in straps and similar work without destroying the quality of the material as is the case with quenched forgings.

Main and side rods have been produced and have been in successful operation for the past few years in which the piston thrust is carried directly from the main rods to the side rods back of the main wheel. This does not in any way reduce the piston thrust that must necessarily come on the main rods. At the same time, however, it does reduce very considerably the piston thrust that must be transferred through the main crank pin into the side rods, thereby alleviating to a very great extent the troubles that have been experienced with large side rod connections at the main pin. Such a design does not increase the total weight of the rods to an extent likely to cause any appreciable increased difficulties from a counterbalance standpoint.

The design of main and side rods as well as main crank pins will always be a vital question in the construction of locomotives. It has been necessary and always will be in designing the rods for locomotives to assume certain arbitrary limits of fiber stress based principally upon past experience. It is impossible to take into account all the stresses produced in rods when a locomotive is in operation, and for this reason the allowable fiber stresses in tension, compression and bending must be taken comparatively small in comparison to the elastic limit obtained in such forgings.

There has already been a great deal written and a number of experiments conducted regarding the proper design of rods to successfully stand up under severe usage and at the same time reduce to a minimum the ordinary difficulties presented from the standpoint of counterbalance. Hollow-bored piston rods, light designs of crosshead and piston, the use of high-tension steel for side and main rods as well as the use of hollow-bored crank pins are familiar to all. More careful attention should be paid to the quality and upkeep of rod bearings and every endeavor should be made to provide bearings of such quality and design that renewals will be reduced.

A main pin designed properly for heavy piston thrust must be so proportioned that the length will bear a certain relation to the diameter within very close limits. On account of the necessity for keeping cylinder centers as close together as possible because of road clearances, if a proper length of main pin is obtained, its proper size presents a difficult proposition. This is one of the great difficulties which the author is confident will be overcome in the near future by the proper application of a design previously mentioned, wherein a large part of the piston thrust is transmitted directly from the main rod into the side rod.

Before the advent of present day large locomotives with their tremendous piston thrust it was not a particularly difficult matter to design a suitable main crank pin. So long as the bearing pressure per square inch of projected area based upon maximum piston thrust was within a limit of 1,600 or 1,700 lb. the main pins would work satisfactorily. The ordinary design of smaller locomotives was such that the main side pin would also be sufficient. It has been found in comparatively recent years, however, that the old rule would no longer apply. In order for the main crank pin to be of sufficient size to withstand heavier piston thrust and still maintain the fiber stress within workable limits, it was necessary of course to increase the diameter proportionately. This brought up the question of rubbing speed. It is a well-known fact that if the rubbing speed is too high, bearings will heat and wear very rapidly regardless of the bearing pressure.

Counterbalance

It is a very difficult matter to separate the question of counterbalance from the design of connecting rods and reciprocating parts. There is a great diversity of opinion in regard to the proper amount of counterbalance which should be applied to locomotives. There are in operation heavy Santa Fe type locomotives which have between 35 and 40 per cent of the reciprocating weights counterbalanced and they are said by traveling engineers to ride easily. The author believes that with our present heavy engines with long wheelbase it is not necessary to balance as much as 50 or 55 per cent of the reciprocating weight. In fact, it is quite possible that we may be able to counterbalance a smaller percentage of

reciprocating weight than has heretofore been attempted, especially for long, heavy engines, provided the revolving weights at the main pin can be properly taken care of. Every effort, however, should be made to balance all of the revolving weights on the main pin. If, for example, we lack 400 lb. of balancing the revolving weight on the main pin, the effect on the track is exactly the same as if we had 400 lb. of counterweight on any of the other wheels to balance reciprocating parts.

There is an added difficulty to this problem, because the action of the counterweight in wheels other than the main is exactly opposite to the force produced by the weight on the main pin which is not counterbalanced. This condition results in increased track stresses, as well as increased stresses in frames and other parts of the locomotive. There is also a tendency at high speeds when a condition like this exists for the main wheel to lift from the rail, while the wheels other than the main are exerting their maximum force on the rail. This reduction of weight on the main wheel at the time when the other wheels are exerting their maximum force on the rail provides a tendency for the main wheel to slip when it is impossible to slip the remaining wheels. No one, it is believed, can give any idea of the stresses which are produced in side rods, frames and other parts of a locomotive due to a condition of this kind. In fact, there have been instances where the rods were torn off and the crank pins loosened for this reason alone.

The author is of the opinion that no definite set rule can be established in this regard, but that each particular design is a study in itself, and wherever revolving weights at the main pin are encountered such that they cannot be properly counterbalanced, steps should be taken to provide the best means possible of reducing revolving weights at this point as well as providing reciprocating parts as light as possible consistent with strength. This of course has been accomplished in the past by hollow boring the main pins and piston rods and by using a light design of piston head, which indicates that a steel having a high elastic limit with the proper elongation and reduction of area should be employed. The use of such steel has already proved that it can be depended upon. One of the principal fundamentals in counterbalance is to keep the reciprocating weight as light as possible.

The Running Gear

On account of the large increase in the size of cylinders of present-day heavy locomotives over those used several years ago, the cylinder centers have been spread until they have reached practically the clearance limitations of the railroads, and the necessity for larger journals to carry properly the increased axle loads has caused the frame centers to be brought nearer together.

This condition increases very materially the distance from the center of the cylinder to the center of the frame, which of itself produces greater strain in the frame and at the same time increased pressure on the driving-box bearings as well as shoes and wedges. In addition to the above, piston thrusts have increased from approximately 65,000 lb. to approximately 150,000 lb., and means must be provided to properly take care of the increased piston thrust along with the increased overhang.

While discussing the subject of frames it is hardly possible to ignore the vital question of frame cross-bracing. Substantial and sufficient cross-braces should be applied between the frames and rigidly bolted thereto to form a rugged structure which will not rattle to pieces. Sufficient bearing for bolts and adequate bolting flanges are a very important feature. At the same time it must be borne in mind that there is a possibility of tying up the frame so rigidly that there will be a tendency for failures ahead of the front pedestal and just back of the cylinder fit at a point where it is practically impossible to obtain sufficient reinforcement.

It seems as though the design of driving boxes and driving-box brasses has not successfully kept pace with the rapid increase in piston thrust. We have in almost general use the same type of driving-box brass which has been standard on locomotives for years. The design is such that the brass extends about half-way down over the journal. Inasmuch as this brass must take up the piston thrust, it is very evident that we shall have trouble in taking care of driving-box brasses until a suitable design is produced—one in which the brass will cover much more of the front and back projected area of the journal than is now the case.

Guiding and Trailing Trucks in Connection with Long Wheelbase

With our present heavy Mikado and Santa Fe type locomotives the length of rigid wheelbase is almost if not quite double the rigid wheelbase in ordinary service 20 years ago. It is unnecessary to comment upon the fact that it is a difficult matter to operate such engines around curves of even comparatively small degree and at the same time prevent the rapid wear of hub liners and driving-box faces, thus increasing quickly the lateral play to a prohibitive point and necessitating work in the shop to overcome it.

Santa Fe type engines with 22-ft. rigid wheelbase are not uncommon. Engines of this type and of this size will weigh in the neighborhood of 400,000 to 420,000 lb. When we stop to think that to move this tremendous mass of material around a 16- or 18-deg. curve a force of many thousand pounds is required, is it any wonder that we obtain rapid flange wear and the necessity for re-turning tires before the proper amount of mileage has been obtained? In the majority of cases, it is believed, the force necessary to properly curve an engine of this kind has been applied at the front truck and the first driver. In most cases types of leading trucks have been used which produce a very small resistance on curves of small degree. In order to prevent rapid flange wear as well as to overcome the development of lateral play unnecessarily, designs have been produced which will give a high initial resistance of the front truck and provide a lateral motion for the front driver with adequate resistance so that some of the guiding force is transferred back to the second pair of drivers.

Since locomotives operate the greater part of the time on tangent tracks, it is necessary to have a high initial guiding resistance which will not be increased when curving. In other words, a flexible wheelbase is produced which has all the requisites of the ordinary rigid wheelbase, but at the same time will overcome many of the difficulties now encountered in an attempt to operate engines of this size and length. Many designs of trailing trucks have been produced with the idea in mind of helping to remedy the conditions which have been noted above. These of course have met in a way the conditions which it was necessary to overcome. There is much yet to be done in producing a trailing truck which will have the proper facilities for equalization of spring rigging and at the same time produce an initial guiding force which can be kept nearly constant, thus avoiding the high final lateral resistance which is found in a good many of the trailing trucks now in use.

In addition to the foregoing some work has been done in the way of producing a design by means of which the lateral play in locomotive driving wheels can be taken up without removing the wheels from under the engine or taking the boxes off from the axles. No doubt in the near future a practical device of this kind will be produced. This is another one of the many problems which can be worked out which will enable the railroads to keep their locomotives in service.

The advent some years ago of the power reverse gear overcame one of the great objections that engineers had to large locomotives. It is a fact that it is almost impossible for one man to reverse one of our large locomotives equipped with the ordinary hand reverse lever. Power reverse has come to be

an essential part of engine equipment and has been found to be economical even though it may be used on a locomotive which could be comparatively easily reversed by hand.

Probably no one thing contributes more to the failure of side rods than the improper adjustment of shoes and wedges. If these are allowed to run loose, stresses in the side rods will amount to a very high figure and it is impossible to determine to what extent they may go. A satisfactory automatic wedge if properly applied and maintained will, no doubt, go a long way toward preventing side rod failures.

Means for Increasing Nominal Tractive Power

All railroads have points on certain divisions where there is a critical grade or the necessity of starting a heavy load under adverse conditions. At such places increased tractive power is required which is not needed elsewhere. We are therefore confronted with the problem of producing a device which can be set to work to increase the tractive power of a locomotive to such an extent that the critical grade or the necessity for increased tractive power to start a train under adverse conditions will be overcome, thus enabling the engine to take its full tonnage over the entire division. This device should be so made that it can be applied when necessary and thrown out when the additional tractive power is not required. Designs have already been produced wherein an additional tractive power of 8,000 or 10,000 lb. has been applied to the trailing trucks of large locomotives. There is also a possibility of applying such a device to the tender truck, thus availing ourselves of the adhesive weight of the tender to help boost the engine over the critical points in a division. There is always present a possible potential boiler capacity which can be brought out by the use of a variable exhaust or other device sufficient to obtain rapid combustion at slow speeds.

What has already been done along this line may be taken as a start in the right direction. A certain amount of development work must be done in order that these necessary improvements may be made to operate satisfactorily. These problems require the co-operation of the railroads to provide the necessary means for trying out such devices which, after having been carefully considered, show that they have possibilities for future use.

The Ash Pan

The question of ash pans is also one needing serious consideration. With the large increase in size of locomotives in many cases we have evidently lost sight of the importance of this necessity. There are in use a number of rules stating what the proper air opening in the ash pan should be, some saying that the ash pan air opening should be equal to the net gas area of the tubes and others that it should be a certain percentage of the opening through the grates. While many of these rules have in a way proven satisfactory, at the same time it would seem that to get at the question logically we should determine the amount of coal that can be burned economically per square foot of grate and then on this basis provide an ash pan air opening that will give the required amount of air to burn satisfactorily the maximum amount of coal which is expected to be consumed. The amount of air that will flow through a given opening in the ash pan, it is believed, can be very closely approximated from the vacuum produced in the smokebox. This, of course, is only a suggestion, and it may be that when the question is looked into more carefully a more desirable and accurate method of determining the required ash pan air opening for proper combustion may present itself.

Lubrication

Lubrication is a subject which has received much attention and a great number of combinations and experiments have been made to determine the most satisfactory method. With our present high superheat the proper introduction of oil into the cylinders and valves of a locomotive is worth serious consideration.

It is common practice in European countries to provide a forcefeed lubricator located very close to the cylinder. The ordinary method which they use in connecting up this lubricator is to provide a pipe to each end of the piston-valve steam chest. This oil supply opens directly over each end of the valve when it is in central position. In addition an oil pipe is supplied to the cylinder at its center. It is reported that by this method there is less carbonization of the oil than when it is fed into the steam pipes or into the center of the piston valve steam chest. Whether or not this is so the author has no means of proving, but it seems logical.

In order to increase the tonnage which a locomotive can haul it is just as vital to decrease the resistance as to increase the power. It is not an impossibility to provide roller bearings for passenger cars and there seems to be no reason why they cannot be used on freight cars. Of course, this would mean very radical changes in design and a gradual displacement of present equipment, but the reduction of rolling resistance and the better facilities for lubrication which would be provided would be sufficient in time to overcome the necessary expense. All this may seem rather far-fetched, but it is at least worthy of consideration.

Conclusion

In summing up the situation, it may be said that the use of the superheater alone has increased the capacity of locomotives when compared with saturated engines of the same design to such an extent that no one would think of building a large locomotive for up-to-date railroad service without the application of superheat. This is one of the greatest strides that has been made in the construction of locomotives in the past few years. We must not content ourselves, however, with what has been done with this one device. The large locomotive of today has become a necessity and is here to stay. What we need to do now is to avail ourselves of the opportunities offered in the application of many of the labor-saving and capacity-increasing devices which have already been worked out and are giving satisfactory service and at the same time look forward to the possibilities of applying other devices which are yet in their infancy, but which have proven beyond doubt that they are well worth our consideration and are of sufficient importance to warrant their adoption. There are many improvements yet to be made in locomotives and it behooves the operating officials of railroads as well as the leading minds in locomotive operation and design to get together and to continue to produce locomotives which in the next 20 years will be as far ahead of our present engines as our present locomotives are ahead of the locomotives that were built 20 years ago. Without the capacity-increasing devices which have been mentioned the large locomotive of today would be impossible—it could not be operated satisfactorily. Our large engines are an absolute justification of these improvements. Further developments are ready at hand and in their use lie the possibilities of still more powerful and economical transportation units built to operate within our present limitations of clearance and permissible rail loads.

The Functions of Management

Functional organization and management was the subject considered by the New York Section of the Taylor Society, on April 21, as reported in the Iron Age. The chief speaker was Henry W. Shelton, who had gained experience in his subject as assistant professor of organization and management at the Amos Tuck School of Administration and Finance, Dartmouth College; as head of the personnel section on the staff of the vice-president in charge of administration in the Emergency Fleet Corporation, and as consulting engineer in

charge of the reorganization work at the Wilmer-Atkinson Company, Philadelphia.

Industry may be likened to an equilateral triangle, the speaker declared, one side being represented by thinking; the second, by feeling, and the third, by doing. In the past we have not known how to organize the feeling side of industry. In its first stage we had an unorganized, decentralized activity. We have now reached the second stage, where production is organized and centralized. And we are just getting into a third stage where particular functions are recognized and are being redistributed among individuals in a sensible way—in other words an organized, decentralized activity. Part of what he said is in substance as follows:

Authority must rest on knowledge of fitness—no longer on "dignity" of position. Don't keep hard and fast to any one group of standards. Keep re-analyzing and changing them as new personnel bring to the task greater or less powers. Openmindedness to criticism is very essential. Every workman should be an inspector. Publicity is a great factor for promoting harmony.

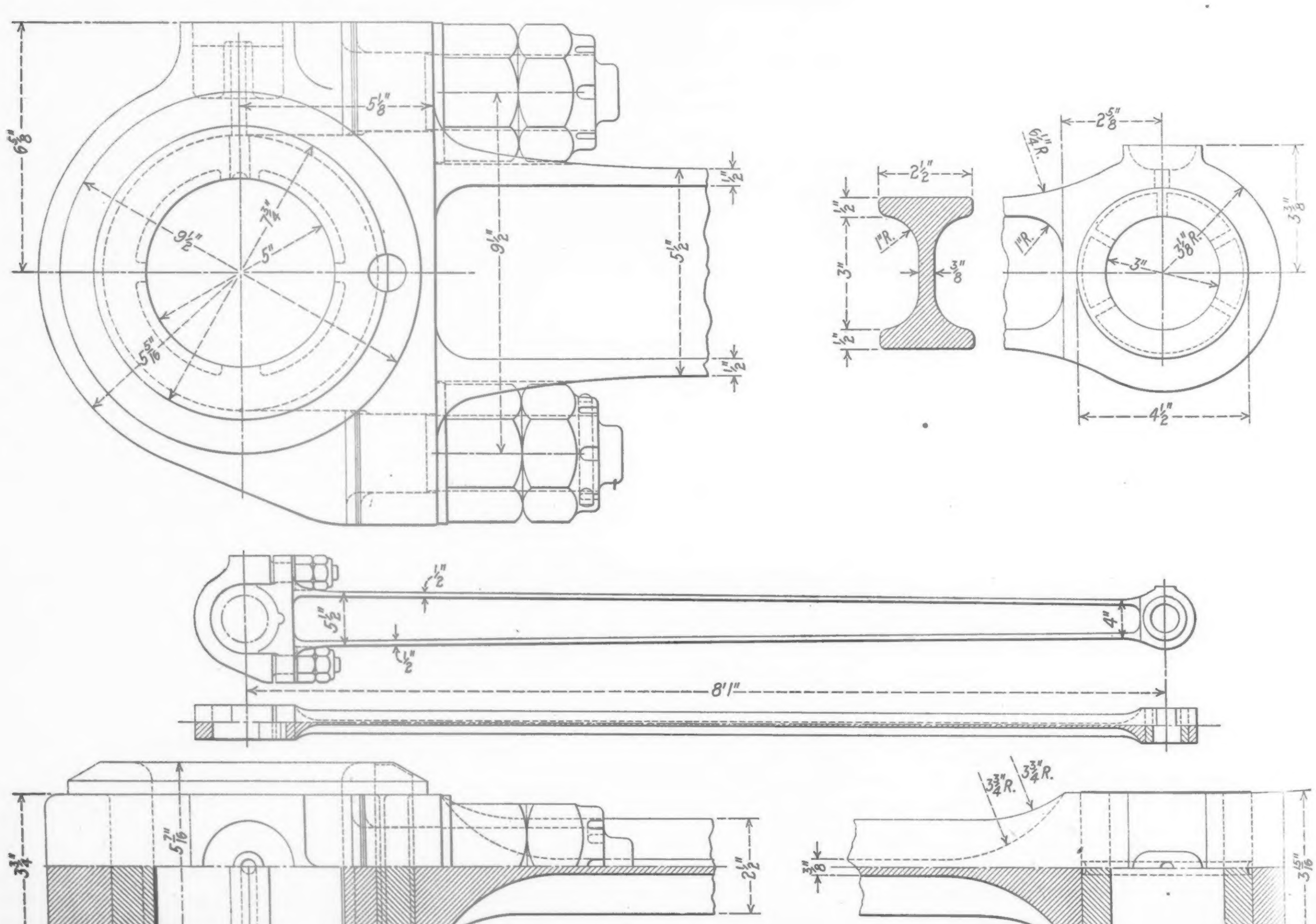
An Accomplishment in Light Reciprocating Locomotive Parts

While the possibilities of alloy steels as a means for reducing the weight of reciprocating parts of locomotives are well known in this country, it would seem that refinements actually accomplished abroad far surpass progress in this direction on American railroads. We are indebted to officers of the mechanical department of the Great Northern Railway of England for the accompanying drawing of the outside connecting rod designed for a new three-cylinder 2-6-0 type locomotive recently placed in service on that railroad.

The three cylinders used on the new locomotives are each 18½ in. in diameter with a 26-in. stroke as compared with two 20-in. by 26-in. cylinders on earlier 2-6-0 type locomotives. The rods for the old locomotives were of carbon steel and weighed 403 lb. each whereas the rods for the new locomotives are of nickel chrome steel and weigh only 295 lb. each. The dimensions and results of tests to which both rods were subjected are given in the following table together with the analysis of each.

	Carbon Steel Rod	Nickel-Chrome Steel Rod
Length	8 ft. 1 in.	8 ft. 1 in.
Weight	403 lb.	295 lb.
Yield limit (tons per sq. in.)	17.0	48.4
Breaking strength (tons per sq. in.)	33.6	58.0
Elongation	.84 in.	.40 in.
Diameter at point of fracture	.53 in.	.37 in.
Reduction of area	56 per cent	57.2 per cent
Ratio, yield limit to breaking limit	50.6 per cent	83.4 per cent
Analysis:		
Carbon	.28	.33
Silicon	.168	.21
Manganese	.686	.60
Sulphur	.033	.032
Phosphorus	.034	.039
Nickel	....	3.42
Chromium	....	.60

Particular attention was given in designing the rods to avoid sudden changes of section and especially sharp corners: the large radii used will be noticed. The strap ends were screwed with a round thread for the same reason. The rods were rough forged and then rough machined to within a quarter of an inch of the full size. They were then returned to the makers and heat treated and then machined to the finished size.



Light Weight Alloy Steel Main Rod Used on Three-Cylinder Locomotives of the Great Northern Railway of England

Principles to Govern Agreements Defined by Labor Board

Decision Terminating National Agreements on July 1 Instructs Officers and Employees to Draw Up New Rules

THE long controversy over the railway employees' demand for the perpetuation of national agreements was ended on April 14 by a decision handed down by the Railroad Labor Board which sustained some contentions of both the carriers and the employees. The award abrogated national agreements, remanded the negotiation of new agreements to the individual carriers and their own employees, and upheld the railroads' interpretation of the principle of collective bargaining and their contention that varying local conditions should govern the fixing of rules and working conditions. In these respects the decision was favorable to the railroads. The award also outlined sixteen principles with which the new agreements should be consistent. This constitutes one of the chief points for which the employees' representatives have been fighting. Accordingly both sides have expressed satisfaction with the terms of the decision.

The hearings prior to the decision, following the cross-examination of General Atterbury as described in the April issue, were uneventful. Voluminous exhibits were presented by W. Jett Lauck, consulting economist of the labor organization. The cross-examination of railroad executives was continued and Frank McManamy, formerly assistant director, mechanical department, division of operation of the Railroad Administration, was called to testify. Judge R. M. Barton, chairman of the board, was called to a conference at Washington with President Harding and Edgar E. Clark, chairman of the Interstate Commerce Commission.

Before the decision was announced, the Labor Board served notice that April 18 would be set as the date of hearing in the disputes between the railroads and the employees over wage scales.

Text of the Board's Decision on National Agreements

After outlining the history of the controversy the decision said in part:

The evidence and arguments submitted in this case support the following conclusions:

The duty imposed by Section 301 on all carriers and their officers, employees and agents to consider and if possible to decide in conference all disputes between carriers and their employees has not been performed by the parties hereto either with regard to the wage or the working conditions portion of this dispute. The record shows that the representatives of the carriers were unwilling to assume the responsibility of agreeing to substantial wage increases. Hence, the conference of March 10 to April 1 on the side of the carriers was merely a perfunctory performance of the statute. Nor was the action of the organizations with regard to the individual carriers more than perfunctory. Naked presentation as irreducible demands of elaborate wage scales carrying substantial increases, or of voluminous forms of contract regulating working conditions, with instructions to sign on the dotted line, is not a performance of the obligation to decide disputes in conference if possible. The statute requires an honest effort by the parties to decide in conference. If they cannot decide all matters in dispute in conference, it is their duty to there decide all that is possible and refer only the portion impossible of decision to this Board.

Although Section 301 has not been complied with by the parties, the Board has jurisdiction of this dispute, as it is and has been one likely substantially to interrupt commerce.

The carriers parties hereto maintain that the direction of this Board in Decision No. 2, extending the national agreements, orders, etc., of the Railroad Administration as a *modus vivendi* should be terminated at once; and that the matter should be remanded to the individual carriers and their employees for negotiation and individual agreement.

S. Higgins

W. L. McMenimen

B. W. Hooper

Three New Members of the Labor Board

The organizations maintain that the national agreements, orders, etc., with certain modifications desired by the employees should be held by this Board to constitute just and reasonable rules; and should be applied to all carriers parties to the dispute, except to the extent that any carrier may have entered into other agreements with its employees. They maintain that local conferences requiring necessarily the participation of thousands of railroad employees for several weeks would constitute an economic waste and would produce a multiplicity of controversies as well as irritation and disturbance. They also urge that to require local conferences would be to expose the local organizations on the several carriers to the entire power and weight of all the carriers acting through the Association of Railway Executives on the conferring carrier, that such a disparity of force would produce an inequitable result highly provocative of discontent and likely to result in traffic interruptions. They, accordingly, insist that the conference should be national.

The carriers maintain that rules negotiated by the employees and officers who must live under them are most satisfactory, that the participants in such negotiations know the intent of the rules agreed to and advise their fellow workmen and officers accordingly thereby avoiding a litigious attitude on both sides, that substantial differences exist as between the several carriers with relation to the demands of the service, necessary division

of labor and other factors which differences should be reflected in the rules, that these local differences can be given proper consideration only by local conferences. The carriers refuse to confer nationally.

The Labor Board is of the opinion that there is merit in the contentions of each party and has endeavored to take action which will secure some of the advantages of both courses.

This Board is unable to find that all rules embodied in the national agreements, orders, etc., of the Railroad Administration constitute just and reasonable rules for all carriers parties to the dispute. It must, therefore, refuse the indefinite extension of the national agreements, orders, etc., on all such carriers as urged by the employees.

This Board also deems it inadvisable to terminate at once its direction of Decision No. 2 and to remand the dispute to the individual carriers and their employees. Such a course would leave many carriers and their employees without any rules regulating working conditions.

If the Labor Board should remand the dispute to the individual carriers and their employees and should keep the direction of Decision No. 2 in effect until agreements should be arrived at, it is possible that agreements might not be arrived at.

The Labor Board believes, nevertheless, that certain subject matters now regulated by rules of the national agreements, orders, etc., are local in nature and require consideration of local conditions. It also believes that other subject matters now so regulated are general in character and that substantial uniformity in rules regulating such subject matters is desirable.

The Board also believes that certain rules are unduly burdensome to the carriers and should in justice be modified. It may well be that other rules should be modified in the interest of employees.

To secure the performance of the obligation to confer on this dispute, imposed by law on officers and employees of carriers, to bring about the recognition in rules of difference between carriers where substantial, to preserve a degree of uniformity in rules regulating subject matters of a general nature, to prevent to some extent the operation in negotiations of a possible disparity of power as between the carriers and their employees, and to enable the representatives of employees of each carrier and the officers of that carrier to participate in the formulation of rules under which they must live, the Labor Board has determined upon the following action.

Decision

1. The direction of the Labor Board in Decision No. 2, extending the rules, working conditions and agreements in force under the authority of the United States Railroad Administration, will cease and terminate July 1, 1921.

2. The Labor Board calls upon the officers and system organizations of employees of each carrier parties hereto to designate and authorize representatives to confer and to decide so much of this dispute relating to rules and working conditions as it may be possible for them to decide. Such conferences shall begin at the earliest possible date. Such conferences will keep the Labor Board informed of final agreements and disagreements to the end that this Board may know prior to July 1, 1921, what portion of the dispute has been decided. The Labor Board reserves the right to terminate its direction of Decision No. 2 at an earlier date than July 1st with regard to any class of employees of any carrier if it shall have reason to believe that such class of employees is unduly delaying the progress of the negotiations. The Board also reserves the right to stay the termination of the said direction to a date beyond July 1, 1921, if it shall have reason to believe that any carrier is unduly delaying the progress of the negotiations. Rules agreed to by such conferences should be consistent with the principles set forth in Exhibit "B," hereto attached.

3. The Labor Board will promulgate such rules as it determines just and reasonable as soon after July 1, 1921, as is reasonably possible and will make them effective as of July 1, 1921, and applicable to those classes of employees of carriers parties hereto for whom rules have not been arrived at by agreement.

4. The hearings in this dispute will necessarily proceed in order that the Labor Board may be in position to decide with reasonable promptness rules which it may be necessary to promulgate under Section 3 above.

5. Agreements entered into since March 1, 1920, by any carrier and representatives of its employees shall not be affected by this decision.

Sixteen Principles to Govern in New Agreement

Exhibit "B," mentioned above, sets forth the principles believed by the Board to be just and reasonable in governing working conditions as follows:

1. An obligation rests upon management, upon each organization of employees and upon each employee to render honest, efficient and economical service to the carrier serving the public.

2. The spirit of co-operation between management and employees being essential to efficient operation, both parties will so conduct themselves as to promote this spirit.

3. Management having the responsibility for safe, efficient and economical operation, the rules will not be subversive of necessary discipline.

4. The right of railway employees to organize for lawful objects shall not be denied, interfered with or obstructed.

5. The right of such lawful organization to act toward lawful objects through representatives of its own choice, whether employees of a particular carrier or otherwise, shall be agreed to by management.

6. No discrimination shall be practiced by management as between members and non-members of organizations or as between members of different organizations, nor shall members of organizations discriminate against non-members or use other methods than lawful persuasion to secure their membership. Espionage by carriers on the legitimate activities of labor organizations or by labor organizations on the legitimate activities of carriers should not be practiced.

7. The right of employees to be consulted prior to a decision of management adversely affecting their wages or working conditions shall be agreed to by management. This right of participation shall be deemed adequately complied with, if and when, the representatives of a majority of the employees of each of the several classes directly affected shall have conferred with the management.

8. No employee should be disciplined without a fair hearing by a designated officer of the carrier. Suspension in proper cases pending a hearing, which shall be prompt, shall not be deemed a violation of this principle. At a reasonable time prior to the hearing he is entitled to be apprised of the precise charge against him. He shall have reasonable opportunity to secure the presence of necessary witnesses and shall have the right to be there represented by a counsel of his choosing. If the judgment shall be in his favor, he shall be compensated for the wage loss, if any, suffered by him.

9. Proper classification of employees and a reasonable definition of the work to be done by each class for which just and reasonable wages are to be paid is necessary, but shall not unduly impose uneconomical conditions upon the carriers.

10. Regularity of hours or days during which the employee is to serve or hold himself in readiness to serve is desirable.

11. The principle of seniority long applied to the railroad service is sound and should be adhered to. It should be so applied as not to cause undue impairment of the service.

12. The Board approves the principle of the eight hour day, but believes it should be limited to work requiring practically continuous application during eight hours. For eight hours' pay eight hours' work should be performed by all railroad employees except engine and train service employees, regulated by the Adamson Act who are paid generally on a mileage basis as well as on an hourly basis.

13. The health and safety of employees should be reasonably protected.

14. The carriers and the several crafts and classes of railroad employees have a substantial interest in the competency of apprentices or persons under training. Opportunity to learn any craft or occupation shall not be unduly restricted.

15. The majority of any craft or class of employees shall have the right to determine what organization shall represent members of such craft or class. Such organizations shall have the right to make an agreement which shall apply to all employees in such craft or class. No such agreement shall infringe, however, upon the right of employees not members of the organization representing the majority to present grievances either in person or by representatives of their own choice.

16. Employees called or required to report for work, and reporting but not used should be paid reasonable compensation therefor.

Following the announcement of the award, spokesmen for the labor organizations hailed it as a complete victory. At the same time E. T. Whiter, chairman of the committee representing the railroads before the Board, in commenting on the decision said in part:

The decision reached has given opportunity for arrangements between individual railways and their employees which can be made much more reasonable than the rules and working conditions established by the national agreements, and which in a large measure can be adapted to the local conditions of each carrier. * * * The entire tenor of the Board's decision is

that the railways should be economically operated, that employees should render efficient labor for all the time for which they are paid, and that the artificial "pyramiding" of wages, which under the present rules has resulted in large waste, shall cease.

Wage Hearings Begin

In accordance with an order of the Board, the wage question was reopened on April 18 when hearings were started to determine what constitutes a just and reasonable wage under present conditions for various classes of employees. At the time the Board's announcement was made, disputes between 26 railroads and their employees had been certified. When the hearings began the Board had docketed 92 disputes. These were consolidated into one case although each carrier was granted the right to make a separate presentation.

The fact that the three new members of the Board were not present at the beginning of these hearings led to vigorous but ineffective protests against the opening of the case on the part of representatives of the employees. The Board did, however, grant a time concession in allowing the carriers and unions, instead of one day each for the presentation of their cases, as it had announced, five days each for this purpose. The Board also ruled that there would be a week's intermission between the carriers' presentation and that of the unions and that an additional week would be allowed for rebuttal.

The railroad's arguments for wage reductions were opened by J. G. Walber, speaking on behalf of the eastern carriers

Photo by International

From Left to Right: F. P. Walsh, B. M. Jewell and W. Jett Lauck

and taking up those arguments which are common to all of the roads in that territory.

He presented a memorandum and statistical exhibits showing the reductions in wages in other industries and in the cost of living which have occurred since the present railway wage scales were fixed by the Board in July, 1920.

Mr. Walber showed by bulletins issued by the Bureau of Labor Statistics of the United States Department of Labor dealing with wage rates in a dozen important branches of industry, that very substantial reductions of pay were made in these industries in the period from January to March, 1921. The statistics cited, Mr. Walber pointed out, "indicate a general and widespread reduction in wages from 10 to 30 per cent—the majority of reductions are 15 per cent or over."

Mr. Walber also submitted statistics regarding the reductions in the cost of living, based upon compilations made by various commercial agencies and also by the Bureau of Labor Statistics and the National Industrial Conference Board.

"The latest figures available from the Department of Labor," he said, "are for the period ending December, 1920, while the National Industrial Conference Board has compiled its figures to March, 1921. By reference to the declines from the peak (July, 1920, when the present wages were fixed) to December, 1920, as shown by these tables, it will be observed that the Department of Labor Statistics indicate a decline in the cost of living of 7.4 per cent, and the figures of the National Industrial Conference Board a decline of 7.1 per cent. The decline to March, 1921, according to figures of the National Industrial Conference Board, is 17 per cent, and if the Department of Labor figures for March, 1921, were available it is reasonable to assume that the similarity in the results obtained by both organizations would have continued."

In substance, the exhibits filed by Mr. Walber showed that when the present railway wages were fixed in July, 1920, the cost of living was 104.50 per cent more than it was in 1914, while in March, 1921, it was only about 67 per cent more than in 1914, and is still declining. These exhibits also indicated that the average railway wage per annum is now about 133 per cent more than it was in 1914.

Individual Carriers Present Their Cases

Following the presentation of these two general statements, the individual carriers began the submission of volumes of statistical analysis, charts and data relating largely to decreases in the cost of living and the wages being paid by outside industries for both skilled and unskilled labor at various points and comparisons between this data and respectively the increases which have taken place in the wages of railway employees and the present scale of railroad wages.

One of the first large roads to present its case was the Pennsylvania whose statement and brief to the Board said in part:

We desire to call particular attention to the studies made of wages paid in outside industries marked Exhibit No. 8 which is the result of a study of 1,235 plants and covers over 155,000 employees, or approximately three times as many employees as in these trades on the Pennsylvania. This exhibit clearly shows that the preponderating rates paid in outside industries are generally below those proposed in the carriers' submission and, in addition, it is shown that there have been further reductions since the information was first obtained.

The exhibit referred to in the preceding paragraph shows that in comparison with the prevailing rate of 85 cents an hour now being paid by the Pennsylvania to shop employees and 62 cents an hour to helpers, the weighted average rates of pay in 1,235 outside industries for similar work are as follows:

Number of men	Occupation	Weighted average rate per hour
51,586	Machinists	64.7 cents
4,536	Blacksmiths	66.1 cents
10,271	Boilermakers	64.3 cents
7,364	Sheet metal workers	65.8 cents
6,296	Electrical workers No. 1	60.9 cents
3,247	Electrical workers No. 2	61.9 cents
23,198	Carmen	60.9 cents
10,870	Moulders	70.0 cents
38,138	Helpers	49.4 cents

New Members of the Labor Board

President Harding on April 16 sent to the Senate his nominations for three appointments on the Railroad Labor Board to succeed the three members whose terms expired on April 15. The new appointees are Ben W. Hooper, former governor of Tennessee, as a member of the public group succeeding Henry T. Hunt; Samuel Higgins, former general manager of the New York, New Haven & Hartford, and more recently vice-president of the Vapor Car Heating Company, to succeed W. L. Park of the railroad group, and W. L. McMenimen, deputy president of the Brotherhood of Railroad Trainmen, to succeed J. J. Forrester of the labor group.

A FREIGHT TRAIN moving before daylight! Just think of it! A press dispatch from Winnipeg reports Canadian wheat and flour, sold to American dealers, as being "rushed across the border" to avoid the heavy duty that would be imposed should the Fordney tariff bill become law. "A special Canadian National train crossed the line before daylight today, carrying scattered shipments."

The Advantages of the Exhaust Steam Injector

A Considerable Saving in Fuel Is Effected by This Device, Which Is Extensively Used in Foreign Countries

BY CLARENCE ROBERTS

THE exhaust steam injector is used for boiler feeding on a great many locomotives in England and the British colonies, and to some extent in France. In England and the British colonies there are about 4,000 in use, and it is claimed in England the device effects an average saving in fuel consumption of 10 per cent.

The writer has ridden on English and French locomotives running on railroads in France equipped with exhaust steam injectors, and it was observed they were operated with the same facility as the live steam injector, evidently giving no more trouble than the latter. The engine crews seemed to like and take an interest in them, operating them on all occa-

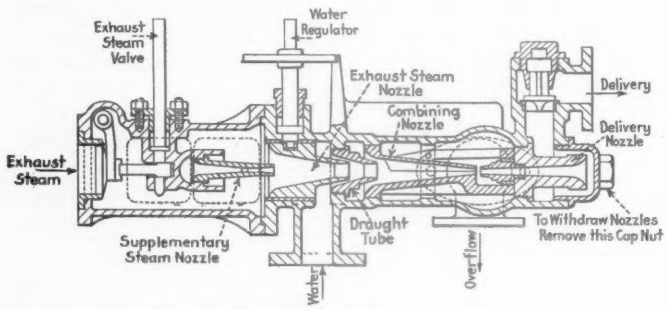


Fig. 1—Exhaust Injector and Valve

sions practicable in preference to live steam injectors, a fact that argues well for it. Operating officials spoke favorably of this type of injector and said that their operation was quite as simple as the live steam injector and maintenance costs were little or no greater. A motive power official of the Northern Railway (France) said his road a few years ago built some very heavy 4-6-4 type suburban locomotives which were over-cylindered and consequently bad steamers. They were afterward equipped with exhaust steam injectors which so improved their steaming performance that they made too much steam even after enlarging the exhaust nozzle openings.

The exhaust steam injector was invented in England about the year 1876 and the early types when working with steam at atmospheric pressure were capable of feeding against boiler pressures up to 70 lb. per square inch. Since its invention it has been improved so that now it is as reliable as the modern live steam injector for locomotive boiler feeding. The latest types present several new and important features and represent a very great advance over all previous types. They restart automatically and when working with exhaust steam at atmospheric pressure are capable of delivering against a pressure of 120 lb. per square inch. With the addition of a small supplementary live steam jet the exhaust injector can feed against pressures up to 300 lb. per square inch. An auxiliary steam nozzle is provided for use when the locomotive is not using steam.

Principle of Operation

Few persons in this country have ever heard of the exhaust steam injector. To those who have read of it, it seems more or less of a mystery and contrary to all accepted principles that exhaust steam at atmospheric pressure should be able to force about ten times its own weight of water into a boiler under pressure. This seeming paradox, however, is easily explained when the action of the exhaust steam on the water is considered, for the same principles are involved as with the live steam injector, that is, a jet of steam moving at high velocity is condensed by a body of water moving at a low velocity; the momentum of the steam jet being transferred to the water, producing a combined jet moving with a resultant velocity sufficient to overcome the boiler pressure. While exhaust steam at atmospheric pressure has no velocity relative to the atmosphere, yet if it is allowed to issue into a vacuum, it has a very high velocity; the velocity of exhaust steam at atmospheric pressure flowing into a perfect vacuum is more than 2,000 ft. per second.

It is well known that when steam is condensed a vacuum is created, the degree of which is dependent upon the temperature of the water of condensation. In the exhaust steam injector a very high degree of vacuum is obtained by the condensation of the exhaust steam by the feed water in the combining nozzle of the injector. The highest vacuum is at the point of the steam nozzle where the steam and water meet. A vacuum of 24 to 26 in. of mercury is obtained, so that the exhaust steam flows in at an exceedingly high velocity. It there meets the feed water, and being condensed by it, gives up its momentum to the combined jet, which then flows along the combining nozzle where complete condensation takes place. The jet leaves the end of the combining nozzle at a velocity which is sufficiently high to carry it forward through the delivery nozzle and into the boiler. It will thus be seen the working of the injector is not dependent on steam being supplied under pressure as is so often supposed, the sole determining factor being the steam velocity.

A sectional view of the double jet type injector is shown in Fig. 1. This comprises a casing containing the various

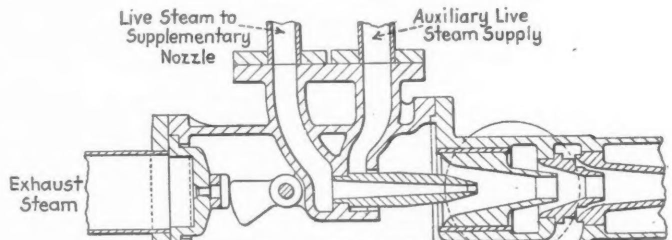


Fig. 2—Automatic Exhaust Valve

nozzles and also branches for the delivery, overflow and water pipes. The nozzles consist of the exhaust steam nozzle, draft tube, combining or flap nozzle and delivery nozzle, while in the exhaust valve casing is fixed the supplementary steam nozzle which projects into the exhaust steam nozzle. The exhaust steam entering the injector passes into the main central exhaust steam nozzle, at the mouth of which it meets the feed water. Condensation immediately takes place, a very high degree of vacuum being formed, and the combined jet flows forward at a high velocity through the draft tube into the combining nozzle. The region of high vacuum extends to the entrance of the combining nozzle, and at this point a second supply of exhaust steam is admitted, which, flowing

in at a very high velocity, impinges on and is condensed by the combined jet, imparting to it a further supply of energy, so increasing its velocity. After passing through the combining nozzle, the jet enters the delivery nozzle, where its velocity is reduced, the kinetic energy being changed into pressure energy, and leaving the injector, the water passes into the boiler. This type differs from the live steam injector in having a steam inlet nozzle of a much larger cross sectional area than that of a live steam injector of similar capacity, this being necessary to provide for the large volume of exhaust steam which must be passed.

An enlarged sectional view of the automatic exhaust valve is shown in Fig. 2. This governs the supply of exhaust steam to the injector, acts as a check valve when operating the injector with auxiliary steam when the engine is standing or running with steam shut off, and enables it to start automatically if the jet is in any way broken. As before stated, the exhaust steam alone develops a pressure of 120 lb. and for higher pressures a small jet of live steam is introduced

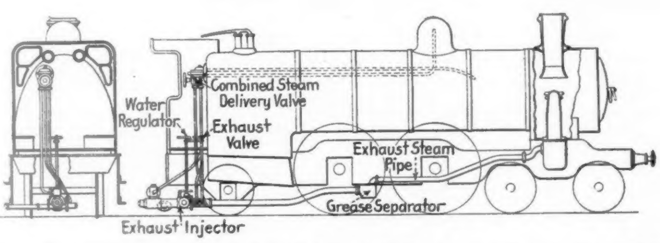


Fig. 3—Arrangement of the Exhaust Injector on the Locomotive

through the supplementary nozzle. The steam supply for this nozzle is obtained through the passage of the exhaust valve casing shown in Fig. 2, from a pipe connected to a supplementary steam valve on the boiler. The small jet of steam introduced through this nozzle gives the additional pressure required to feed the boiler. Water regulation is effected by varying the area for the entrance of water into the nozzles, by moving the exhaust steam nozzle to and fro, so that the surrounding area between the end of the exhaust nozzle and the draft tube is varied, and consequently the quantity of water entering is regulated according to the amount required. When necessary to work the injector as a live steam injector (when the locomotive is not using steam), a supply of live steam is introduced into the automatic exhaust valve casing through the auxiliary steam branch, entering the injector at the annular nozzle surrounding the supplementary nozzle. This supply flows into the exhaust steam nozzles, replacing the exhaust steam, and the injector works exactly as when exhaust steam is used, being as reliable and simple an instrument as any live steam injector, and equally prompt in starting and certain in action.

The exhaust steam injector is capable of delivering against pressures as shown on the following table:

Exhaust Steam Pressure Lb. per square inch	Delivery Pressure Lb. per square inch
1	120
5	150
10	180
15	210
Atmospheric pressure augmented by small jet of live steam from supplementary nozzle	300

In Fig. 3 is shown the method of applying this apparatus on a British type of locomotive. This is diagrammatic only and can be modified to meet the requirements of design of any type of locomotive. A grease trap is necessary in the exhaust pipe. The size of injector known as No. 13, having a 4½ in. exhaust pipe and 2¼ in. delivery pipe, has a capacity of 3,800 gallons of water per hour using exhaust steam in connection with the supplementary jet.

In their efforts to increase the operating capacity and efficiency of the steam locomotive in America railroad men seem to have overlooked or not realized the importance of the exhaust steam injector as a heat saving appliance, for it should not only prove decidedly more efficient than the live steam injector, but everything considered should be comparable with the feed water heater in point of economy.

For boiler feeding the injector has practically one hundred per cent thermal efficiency and its first cost and cost of maintenance is less than a boiler feed pump, though the live steam injector is not the most economical means for feeding a boiler if waste or exhaust steam is available and can be utilized for heating the feed water, but we must not lose sight of the fact that in feed water heating economy comes only from utilizing heat that is now going to waste for it cannot be considered a saving to utilize the exhaust steam from an appliance that replaces the injector for boiler feeding.

The advantages that should be derived from the use of the exhaust steam injector may be briefly stated as follows:

(a) Low first cost and low maintenance costs.
(b) Low rate of depreciation.
(c) Simplicity of design and ease of operation.
(d) The utilizing of exhaust steam for feed water heating which results in saving both water and steam and consequently fuel.
(e) Reduction in back pressure in the locomotive cylinders.

There should be a field for the exhaust steam injector in America. In England an average fuel saving of 10 per cent is claimed for the exhaust steam injector, and with our relatively higher back pressures we should obtain even a greater saving, so that the net saving in money probably would be as great or possibly greater than with feed waterheaters for which a 15 per cent saving is claimed.

The Rusting of Steel Containing Copper

It is generally believed that iron containing copper in amounts of small fractions of one per cent is less liable to rust than iron free from copper. To investigate this problem, comprehensive tests extending over six years were started in 1913 by Professor Bauer for German iron works. These works sent Thomas and Siemens and other steel in large sheets to be tested both with the scale on and after the scale had been removed. The steel contained about 0.1 per cent carbon, 0.5 per cent manganese and phosphorus and sulphur up to 0.09 per cent, nickel up to 0.2 per cent and chromium 0.04 per cent maximum. Copper was added in percentages up to 0.35. The weighed sheets were exposed to various atmospheres and liquids and the rust was removed and weighed.

The specimens were exposed for over four years in good country air, but the influence of the copper content on the rapidity of rusting was not noticeable. In the salt spray near the ocean, the rusting was more marked, but again the copper made no difference. In the impure air of an iron district, however, the effective influence of the copper was perceptible. In all cases the nickel in the steel also seemed to prevent rusting. Sheets were buried in slag sand and the corrosion of the steel indicated that the influence of the copper was to protect the Siemens steel and to hasten the corrosion of the other steel.

Summing up the tests, it would appear that in the presence of relatively high percentages of carbon dioxide and of sulphur dioxide, a slight percentage of copper and of nickel as well, seemed to retard the rusting of steel.

Electrolytic tests were conducted with a specimen suspended in dilute sulphuric acid and it was found the steel suffered less corrosion under these circumstances when a small percentage of copper was present than in the absence of copper. This was particularly marked in the case of steel

relatively high in phosphorus. The copper seemed to counteract the evil effects of the phosphorus. Even in these tests the anti-corrosive effect of the copper on the steel was not strong, however.

The Cost of Boiler Scale

BY W. F. SCHAPHORST

No one disputes the statement that scale is a bad thing, that it has caused and is causing serious losses. The actual money loss due to a definite thickness of scale is a variable quantity, for much depends upon the kind of scale, whether carbonate or sulphate, hard or soft, etc.

The most commonly used rule for determining the money loss is that given in Sames' Mechanical Engineering Handbook as follows: "Scale of 1/16 in. thickness will reduce boiler efficiency 1/8; and the reduction of efficiency increases as the square of the thickness of scale."

The chart shown herewith is based upon the above rule.

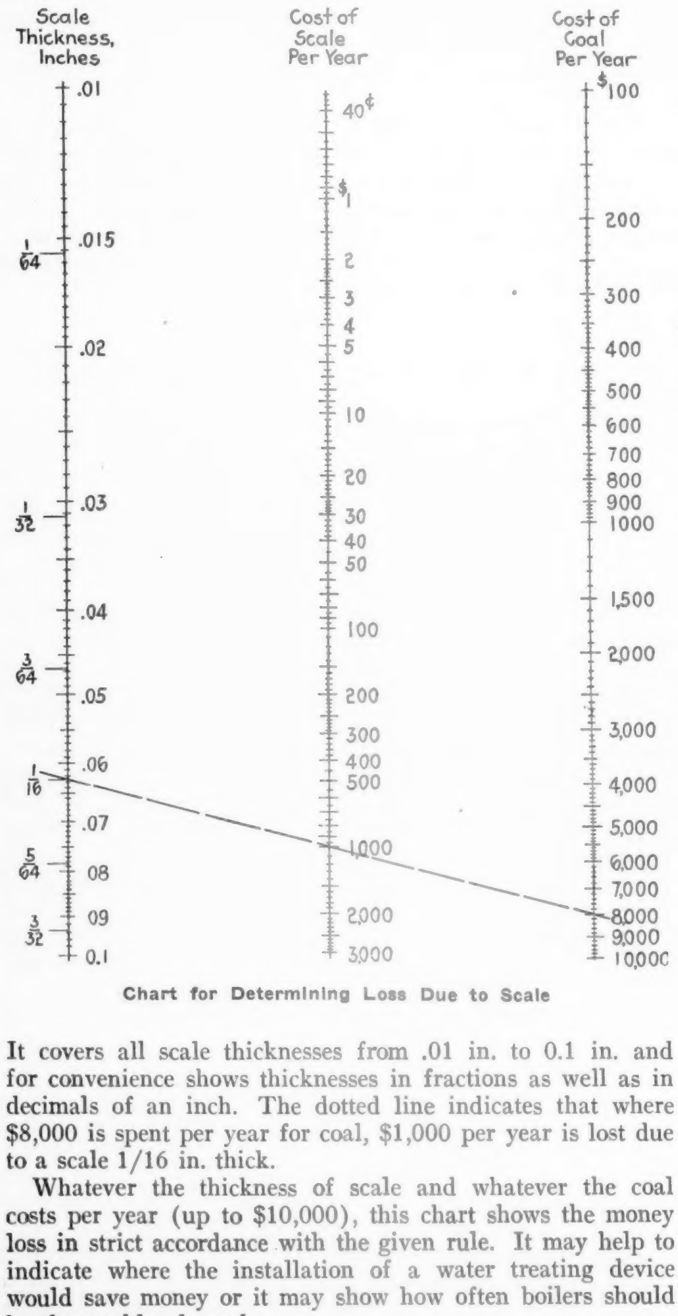


Chart for Determining Loss Due to Scale

It covers all scale thicknesses from .01 in. to 0.1 in. and for convenience shows thicknesses in fractions as well as in decimals of an inch. The dotted line indicates that where $8,000 is spent per year for coal, $1,000 per year is lost due to a scale 1/16 in. thick.

Whatever the thickness of scale and whatever the coal costs per year (up to $10,000), this chart shows the money loss in strict accordance with the given rule. It may help to indicate where the installation of a water treating device would save money or it may show how often boilers should be thoroughly cleaned.

Comparison of Steam and Electric Locomotives

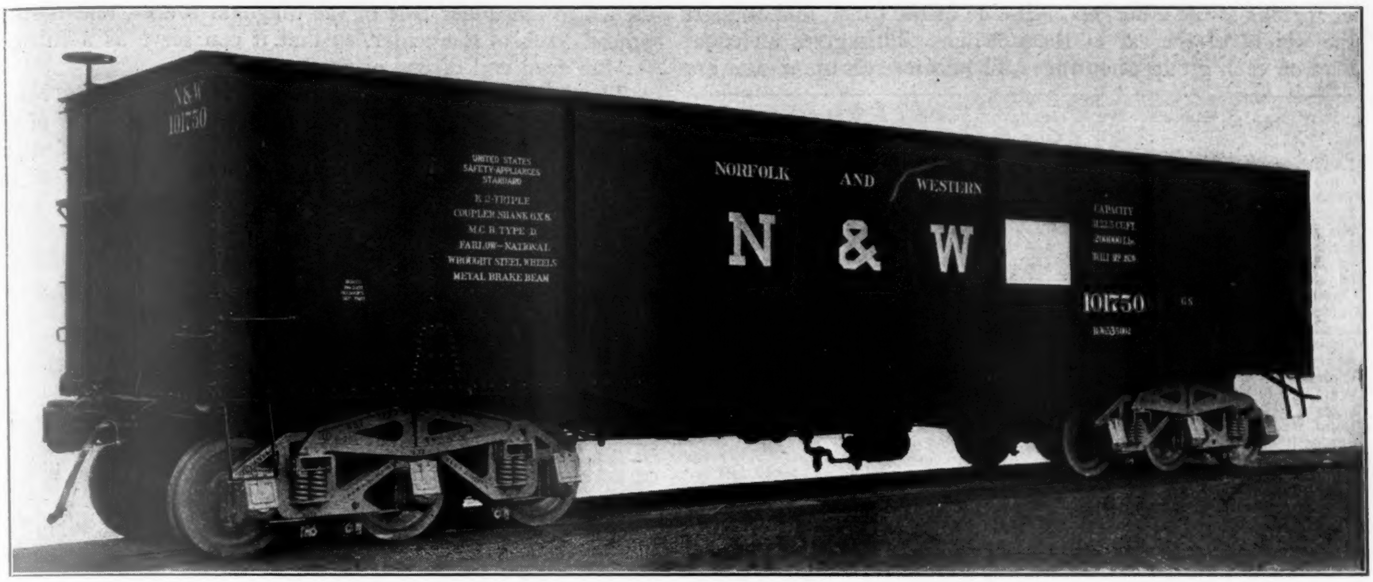
At a meeting of the Franklin Institute held at Philadelphia on April 14 two papers were read on steam and electric motive power. The characteristics of the electric locomotives were discussed by N. W. Storer, general engineer of the Westinghouse Electric & Manufacturing Company, while the characteristics of the steam locomotive were treated by A. W. Gibbs, chief mechanical engineer of the Pennsylvania System.

Mr. Storer stated that he considered it probable that there would gradually be a radical evolution of operating methods in order to utilize the electric locomotive most effectively and discussed some of the factors to be considered in this connection. An important advantage would result from making the speed of passenger and freight trains more nearly uniform, as could be done advantageously with electric motive power. On account of its greater reliability the electric locomotive would not impose the same limitations on the length of operating division as the steam locomotive and greater mileage could be obtained from the individual units. Under certain conditions the use of aerial right over track was of great importance. Electrification opens up possibilities in the use of multiple level stations to increase station capacity and improves the operation of stub-end stations by decreasing the number of switching movements. In concluding, Mr. Storer discussed at some length the relative advantages of various types of motors and compared the speed-pull curves with those of typical steam locomotives.

Mr. Gibbs confined his remarks to the mechanical problem of transmitting power from the motors to the wheels and the behavior of locomotives as vehicles. He stated that while the transmission of power in electric locomotives seems simple it really is very difficult and while the electrical features of the motive power were often satisfactory, the mechanical features were troublesome. After discussing briefly the various types of transmission, Mr. Gibbs outlined some of the difficulties encountered in designing locomotives for high speed. In developing the design of Pennsylvania electric passenger locomotives, tests were conducted to determine the riding qualities of electric engines with various wheel arrangements. A section of track was prepared especially for measuring the stresses, a record being obtained by the impression of a steel ball on a steel plate inserted in special ties. The tests showed that a high center of gravity was advantageous and that symmetrical driving wheel arrangements were unstable. Some of the electric engines proved very destructive to the track and as a result of these tests, a design of locomotive with wheel arrangements corresponding to two eight-wheel engines facing in opposite directions and with motors above the wheels was adopted. In conclusion, Mr. Gibbs stated that there was still much to learn with regard to the behavior of electric locomotives as vehicles and further tests should be made to determine the most satisfactory types.

PRODUCTION OF SOFT COAL in the week ended April 16, was marked by a slight but distinct recovery, says the weekly bulletin of the Geological survey. The output is estimated at 6,525,000 net tons, an increase of 416,000 tons over the week preceding and the largest since the second week of March. For several months the output of the mines has been very low.

SINCE THE PERIOD immediately preceding the war, the number of freight cars on the Italian railways increased from 90,000 to 120,000, while the number of locomotives in the same period fell from 4,400 to 4,200. This diminution accompanied an increase in the length of line operated amounting to 900 miles. Locomotives have not yet recovered from the hard usage undergone in meeting war demands. Proper repairs and the building of new locomotives were slighted during hostilities, and since the cessation of hostilities various dislocations and labor conditions have interfered with construction work in this line.—*Commerce Reports.*

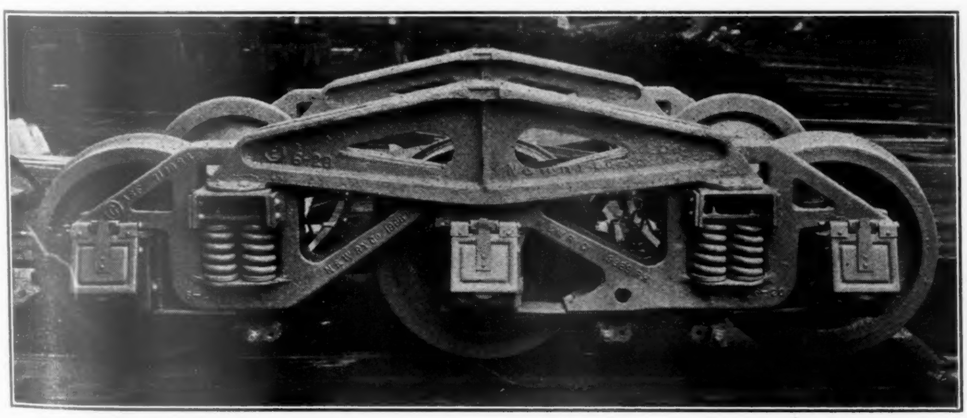


New Norfolk & Western 100-Ton Coal Cars

Body Supported on Side Bearings Instead of Center Plate—New Type Six-Wheel Truck

BY JOHN A. PILCHER
Mechanical Engineer, Norfolk & Western

THE lightest car for its load carrying capacity ever built for heavy train service is illustrated in the accompanying drawings and photographs. An order of 500 of these cars is now nearing completion at the Roanoke shops of the Norfolk & Western, under the supervision of A. Kearney, superintendent of motive power. The advantages of a car of such light weight can be judged from an estimate of the cost of operation prepared in connection with this design. It has been computed that if all these cars could be kept running at the same rate that the first one operated for the first three months, (about 90 miles per day), the additional earnings over those of the previous large capacity cars built by the Norfolk & Western, would pay for them in five years. This accomplishment is due in part to the light weight of the trucks and body and in part to the larger cubic capacity.



Side View of the New Type Truck, Which Carries the Load on the Side Bearings

The special feature of the design is the truck which carries the load on the side bearings instead of on the center plate. This arrangement not only gives perfect equalization of loads between the wheels at all times, but reduces the oscillation of the car to a minimum and contributes very materially to the lightness of both body and trucks. The average weight of car and lading is very near 253,500 lb., the A.R.A. limit for a six-wheel car with 5½ in. by 10 in. journals. The general dimensions and weights of the car are shown in the tabulation. The equipment applied to this order includes wrought steel wheels, Miner friction draft gear, type A-18-S, with Farlow single key horizontal yoke draft attachments. Four hundred of the cars are equipped with Westinghouse K-2 triple valves and 100 with the Automatic Straight Air brake. The brake rigging has one brake beam per axle. The hand brake, arranged with a quick take-up, is geared to give braking power equivalent to the air brake.

The truck is of the three-axle, articulated type, mainly of cast steel, with two side frames on each side, secured together over the center boxes. The boxes used are the regular A.R.A. standard, although the design lends itself readily to the use of the semi-pedestal type of box, now in very general use. It is the lightest six-wheel truck of this capacity ever built. The pair of trucks weighs 24,480 lb.

The springs are so located in the frames as to give equal load distribution on the wheels when equal loads are applied to each group of springs.

Beams made to straddle the frames reach from one group

of springs to the other, on each side of the truck, and support the weight of the car at their centers. This gives an equal load on each group of springs. The beams rest upon, and are secured to spring caps tying them together lengthwise of the truck, and are themselves side members of a rectangular, cross-braced centering spider, which serves to hold the two sides of the truck together and in proper relationship. The truck is thus held square. The cross bracing holds the guide for the centering pin on the car body. The keepers, riveted to the outside of the spring caps, and the projecting lugs cast on them, coming inside the side frames, are the guides to hold the frames together and apart. The carrying beams, straddling the frames, are riveted to the top of the spring caps and serve in a like capacity.

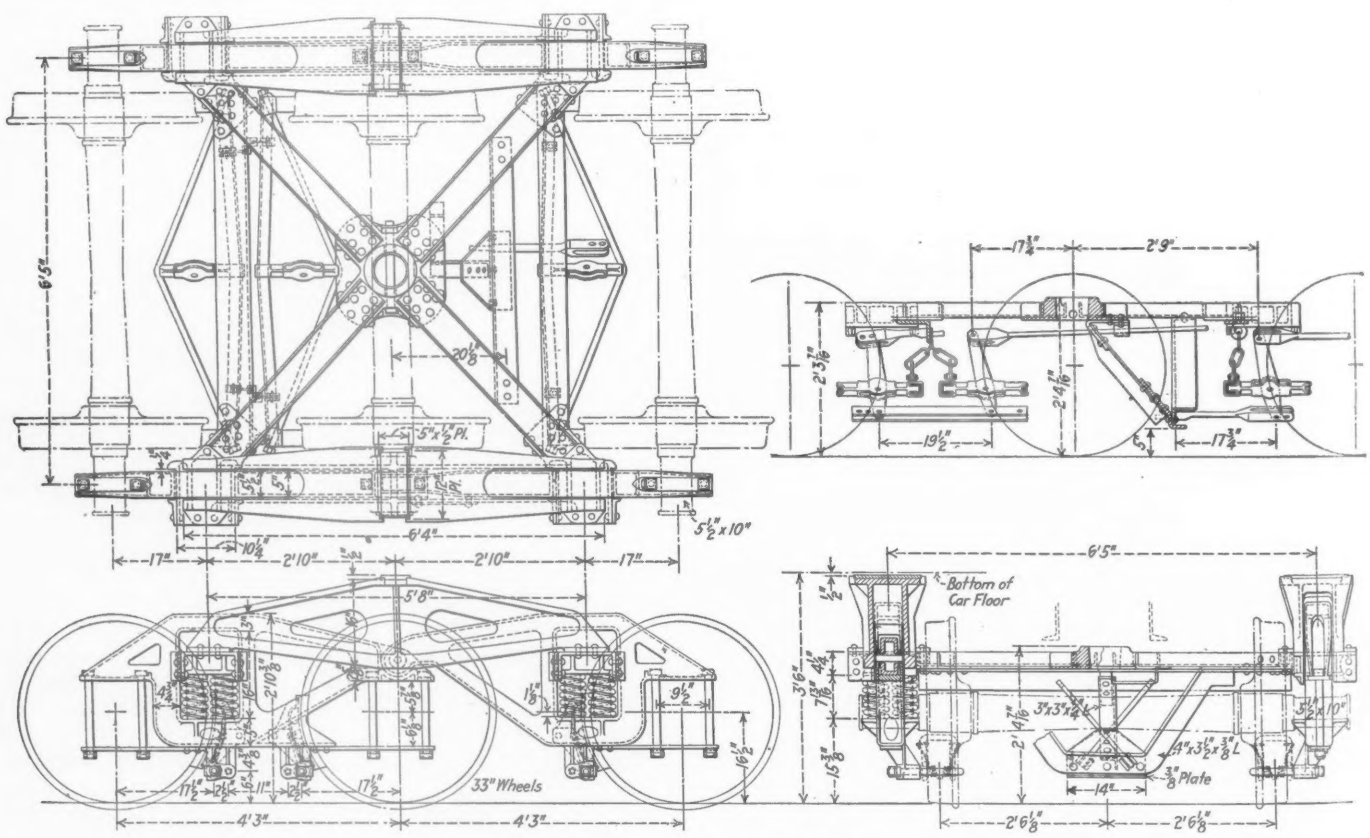
Principal Dimensions and Weights of Norfolk & Western 100-Ton Coal Car

Length over striking plates	43 ft. 9 in.
Coupled length	46 ft. 2 in.
Truck centers	31 ft. 8 in.
Truck wheel base	8 ft. 6 in.
Height from rail to top of car side	11 ft. 0 in.
Height of center of gravity (loaded with 200,000 lb.)	81 in.
Inside length	42 ft. 7 in.
Inside width	9 ft. 6 in.
Outside width	10 ft. 1¼ in.
Cubical capacity—level full	3,122.5 cu. ft.
Cubical capacity—30 deg. heap	513.5 cu. ft.
Cubical capacity—including heap	3,636 cu. ft.
Revenue load	200,000 lb.
Weight of car body	29,020 lb.
Weight of two trucks	24,480 lb.
Weight of empty car	53,500 lb.
Total weight, loaded with 200,000 lb	253,500 lb.
Per cent revenue load of total weight	78.88 per cent.
Weight per foot coupled length	5,491 lb.
Weight of one truck	12,240 lb.
Rail load per pair of wheels	42,250 lb.
Density of load of 200,000 lb	55 lb. per cu. ft.

The design, which is light in weight, readily gives the strength to resist forces in any horizontal direction. One of the cross-tie members is made of an angle to give it stiffness and permit the attachment of the dead end of one of the brake levers. A cable guard, to protect the brake beams from the cable used in hauling the cars up to the dumper, is attached to the under side of the diagonal braces, and is itself braced back to the center, so that it can serve as a fulcrum for the dead end of one of the brake levers.

The brake is arranged, one beam per axle, using No. 2 beams. The pull from the cylinder rods comes to two of the brake levers set on opposite sides of the truck, eliminating any turning movement on the truck. The separation of the brake lever system on the truck into two parts gives independent adjustment for brake shoe and wheel wear, and prevents accumulating lever angularity. All of the adjusting points are readily accessible. The truck is open and can be easily inspected from alongside the car. Since there is a possibility of low or soft spots in the track, the four points on the truck sides, upon which the four groups of springs rest, cannot always be kept in the same plane. The structure resting on the springs must, therefore, be either vertically strong enough to resist the differences in reaction at the four corners, produced by the differences in spring tension, in case any one of the spring seats leaves the normal plane, or it must be vertically flexible enough for any corner to follow the spring seat out of the normal plane, without having set up within it destructive stresses.

This rectangular cross-braced centering spider has been designed to meet these conditions. It was carefully proof tested in the following manner:



General Arrangement of the Six-Wheel Truck

It was rigidly fastened to a stiff frame at the three corners, *A*, *B* and *C*, shown in the diagram of the spider, while the fourth corner, *D*, was attached to the plunger of a rail gaging machine having a stroke of 1½ in. This allowed the alternate lowering and raising of this corner below and above the normal plane. A counter on the machine recorded the number of movements up and down—each number on the counter representing a stroke up and a stroke down. A Berry Strain Gage, with points eight inches apart, was placed at the points on the diagram numbered 1, 2, 3, 4 and 5. Readings were recorded at corresponding points on the diagonals leading to the four corners at about the time

the counter showed 2,212, and again when it showed 81,868. After this a change was made and the plunger of the gaging machine was attached to the corner marked *A*, the corners marked *B, C* and *D* being held rigidly in a plane. The forces applied at one corner to produce the movements ¾ in. above and ¾ in. below the plane of the other three corners of the centering spider. At the bottom of the table are given the results, which show that only a relatively small differential in loading at the corners will overcome the vertical stiffness of the centering spider.

FLEXIBLE TEST OF T-33 TRUCK BOLSTER
Unit strain in inches

		Location 1			Location 2			Location 3			Location 4			Location 5		
No. of vibration cycles	Arm	Up or compression	Down or tension	Total movement up and down	Up or compression	Down or tension	Total movement up and down	Up or compression	Down or tension	Total movement up and down	Up or compression	Down or tension	Total movement up and down	Up or compression	Down or tension	Total movement up and down
MACHINE ATTACHED AT ARM D 4-10-20 TO 4-19-20																
2,212	D	.00045	.00035	.00080	.00041	.00037	.00078	.00032	.00027	.00059	.00024	.00022	.00046	.00014	.00014	.00028
81,868	D	.00035	.00047	.00082	.00039	.00037	.00076	.00032	.00030	.00062	.00025	.00026	.00051	.00016	.00019	.00035
2,212	B	.00046	.00039	.00085	.00038	.00039	.00077	.00036	.00025	.00061	.00022	.00020	.00042	.00011	.00011	.00022
81,868	B	.00042	.00044	.00086	.00039	.00035	.00074	.00029	.00029	.00058	.00020	.00022	.00042	.00012	.00011	.00023
2,212	C	.00027	.00022	.00049	.00025	.00027	.00052	.00020	.00019	.00039	.00007	.00008	.00015	.00002	.00002	.00004
81,868	C	.00026	.00022	.00048	.00025	.00025	.00050	.00015	.00017	.00032	.00007	.00007	.00014	.00002	.00002	.00004
2,212	A	.00032	.00031	.00063	.00035	.00032	.00067	.00023	.00022	.00045	.00014	.00014	.00028	.00001	.00003	.00004
81,868	A	.00031	.00027	.00058	.00029	.00035	.00064	.00022	.00023	.00045	.00014	.00015	.00029	.00003	.00005	.00008
MACHINE ATTACHED AT ARM A 4-19-20 TO 4-27-20																
6,155	B	.00028	.00032	.00060	.00032	.00031	.00063	.00025	.00021	.00046	.00017	.00015	.00032	.00010	.00009	.00019
99,138	B	.00037	.00026	.00063	.00032	.00029	.00061	.00024	.00022	.00046	.00018	.00014	.00032	.00009	.00006	.00015
6,155	D	.00032	.00033	.00065	.00029	.00030	.00059	.00024	.00020	.00044	.00015	.00015	.00030	.00001	.00001	.00002
99,138	D	.00035	.00028	.00063	.00030	.00028	.00058	.00024	.00020	.00044	.00015	.00014	.00030	.00002	.00005	.00007
6,155	C	.00032	.00031	.00063	.00035	.00034	.00069	.00027	.00026	.00053	.00019	.00017	.00036	.00007	.00007	.00014
99,138	C	.00034	.00028	.00062	.00034	.00031	.00065	.00026	.00025	.00051	.00021	.00015	.00036	.00008	.00006	.00014
6,155	A	.00032	.00032	.00064	.00037	.00039	.00076	.00035	.00025	.00060	.00025	.00022	.00047	.00015	.00014	.00029
99,138	A	.00030	.00036	.00066	.00044	.00032	.00076	.00031	.00030	.00061	.00028	.00021	.00049	.00017	.00015	.00032

MACHINE ATTACHED TO ARM D		MACHINE ATTACHED TO ARM A	
Force exerted in compression	808 lb.	Force exerted in compression	516 lb.
Force exerted in tension	522 lb.	Force exerted in tension	613 lb.
Total	1,330 lb.	Total	1,129 lb.

counting was begun over. The readings of the Berry Strain Gage were taken on each diagonal when the counter registered about 6,155, and again when it indicated 99,138. It is to be noted from the table that differences in reading before and after the large number of movements is insignificant,

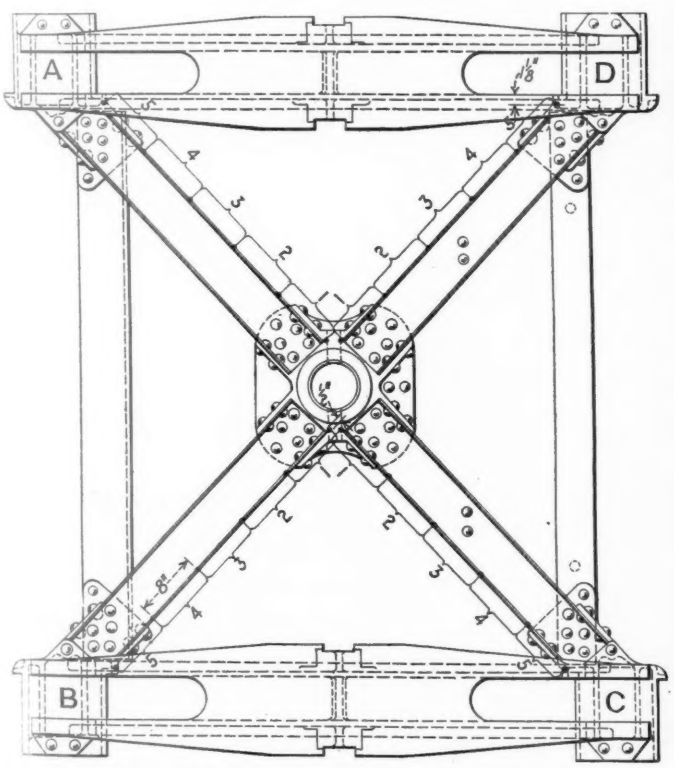
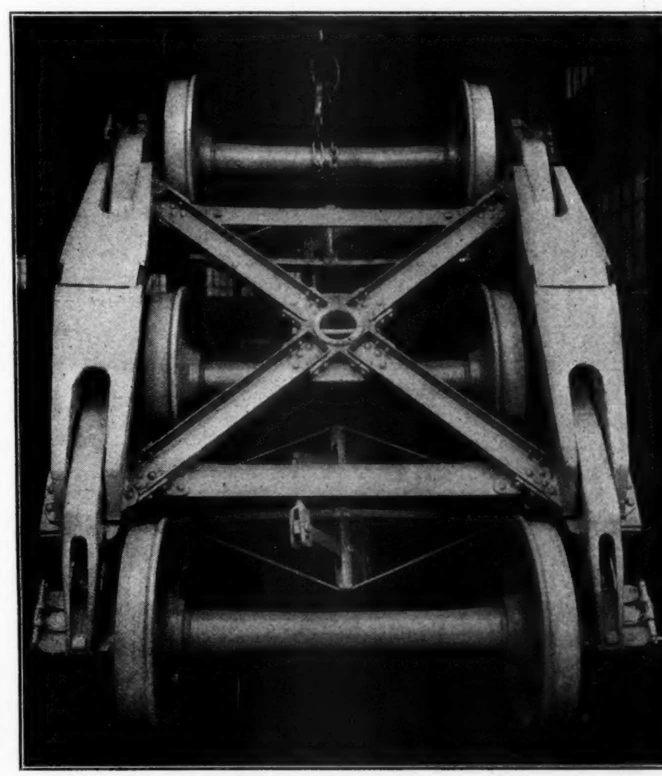


Diagram of Test of Flexibility of Truck Bolster

showing no sign of deterioration. The highest unit strain in inches recorded is .00046, which, when using 27,000,000 as the modulus of elasticity, represents a fiber stress of 12,240 lb. per sq. in. Measurements were made to determine the

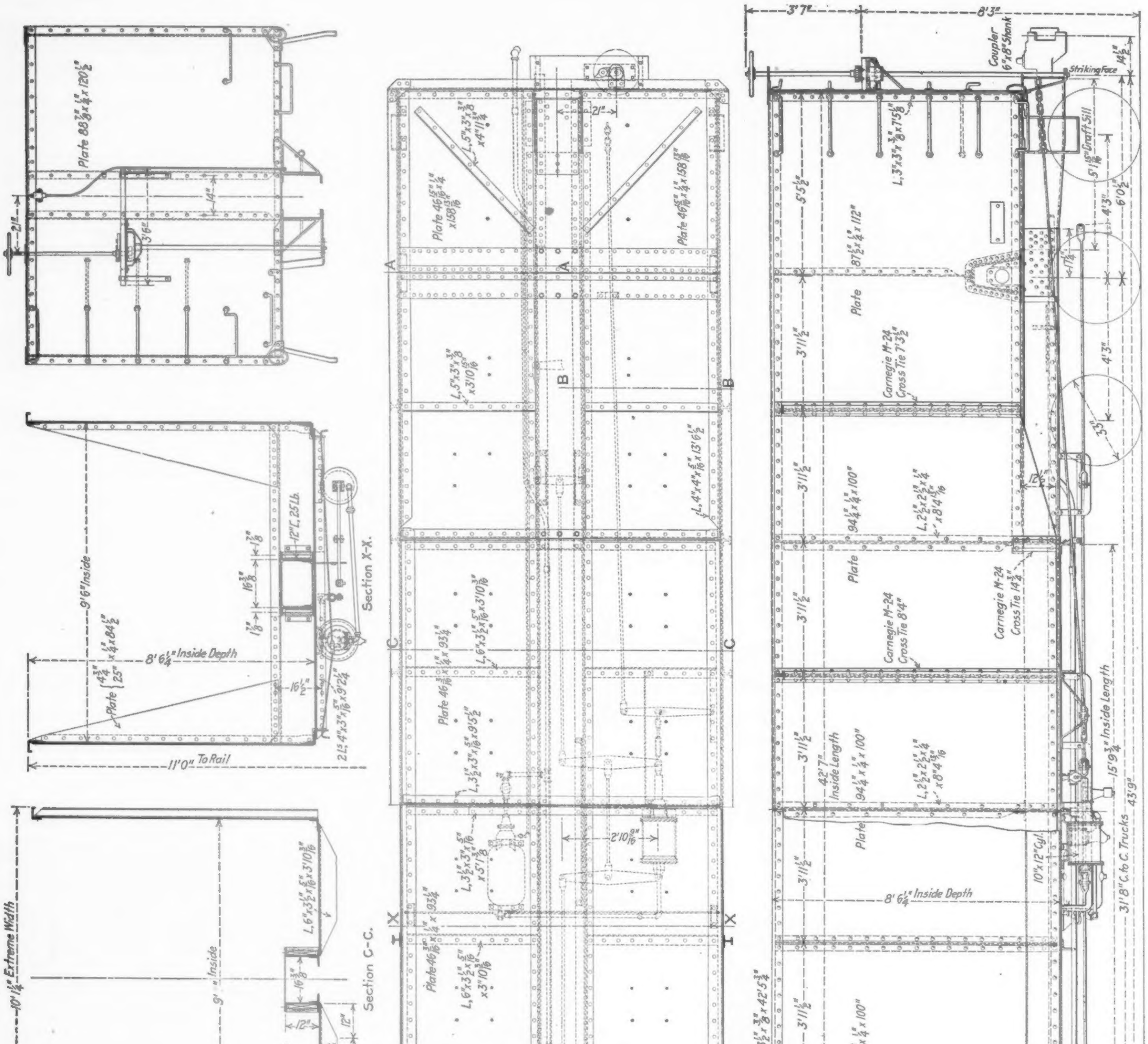
The Car Body

The use of the side bearings, placed over the center of the



A View of the Truck from Above, Showing the Centering Spider and Beams Spanning the Side Frames

truck side frames for load carrying, obviates the necessity for the strong, heavy bolster members from side to side of truck, supporting the load at its center. This not only decreases



Plain, Side and End Elevations and Sections of the Car Body

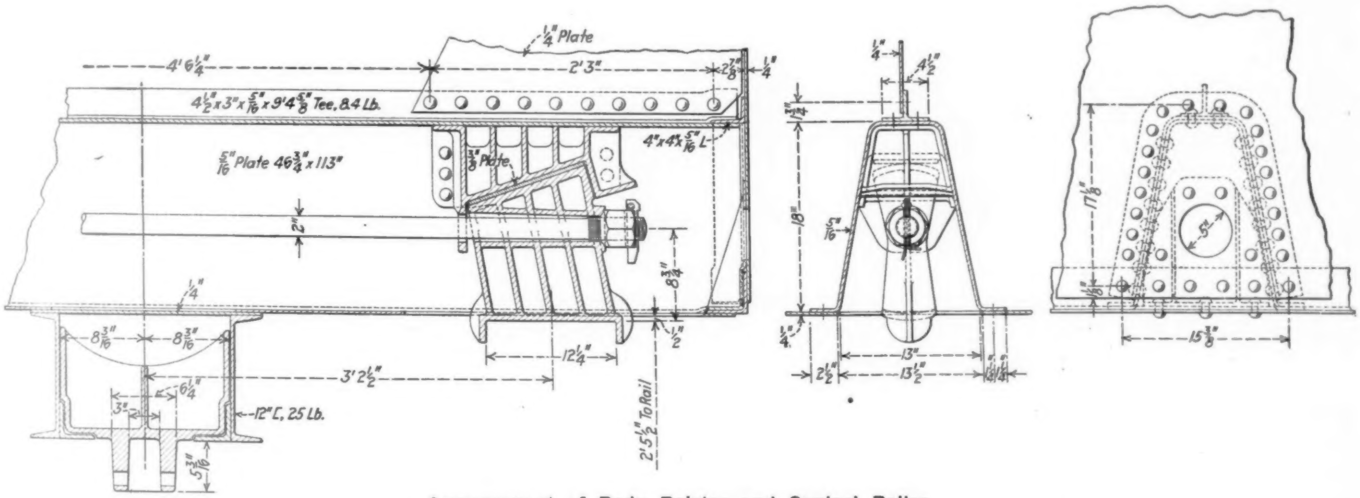
the weight of the truck, but also decreases the weight of the the body bolster show the location and details of the load-carry the load from the car side all the way to the center, but only for the very much shorter distance to the points over the truck side frames.

The general drawing of the car and the arrangement of the body bolster show the location and details of the load-carrying conical rollers. Only enough of the middle section of the conical roller is used to provide sufficient lateral movement at the roller for the car to negotiate a 35-degree curve. The bottom of the roller is limited in its lateral movement by the sides of the opening in the bottom of the car, through which the roller projects. The body bolster is made hollow to allow room for the roller. The bottom face of the roller is set in a horizontal plane, normal to lines of load forces, in order that there may be no horizontal components tending to displace the load-carrying side beams on the truck. The projections on the bottom side of the roller at each end serve as guides for proper placing. Normally, these projections should not come into action for holding the bottom of the roller in place on the truck side beam, as there are no normal forces tending to displace it. The upper sides of the conical rollers incline toward the center. The lateral component of

large portion of the surface, requiring very little riveting to hold it. The holes in the sides of the car are used for entering and securing the tie rod connecting the rollers. They are reinforced on the inside of the side plates with bracket castings and furnish a place for a special hook provided with the wrecking outfits, for lifting the car body in any emergency. Some such arrangement is necessary since the use of ordinary hooks indiscriminately at any point on the loaded car would give such heavy concentration of loading as to tear and mutilate the car body.

A tee is used to increase the section of the top flange of the bolster girder, and its top extending web serves for the attachment of the bolster gusset plate. This gusset plate connection with the side of the car, together with the beaded angle at each end of the bolster, connecting the bolster web plates with the car side, transfers the load coming from the car side through the body bolster to the roller seat, without undue concentration at any point. The car body bolster is placed above the car floor line so as to give room under the car for the supporting beam on the truck over the center box and truck side frames. This allows reasonable depth and economy in the design of the beam.

On a hopper car the hollow bent plate bolster can be placed



Arrangement of Body Bolster and Conical Roller

reaction against the inclined surface on the roller seat is taken up by compression in the body bolster and tension in the rod tying the two opposite rollers together. In case anything should happen to this rod, these reactions will all be within the roller seat itself. The outside end of the roller seat is made of sufficient strength to take care of these forces if the occasion arises.

The tie rod passing through a slotted hole in the inside projecting lug on the seat serves to hold the rollers in place in case the car is jacked off the trucks. The roller is guided, on its top side, by the pocket in the seat. It is cast of high carbon steel, and bears against hardened-steel plates, top and bottom. It is made long and of large diameter, reducing to a minimum the probability of flattening the contact surfaces during any reasonable period of service.

The use of conical rollers of large size makes this approximately an anti-friction bearing, and reduces to a minimum the forces needed to rotate the truck under the car. Any slight flattening of the contact surfaces that might occur after a long period of service would only very slightly increase the forces needed for the turning. Even if after years of service the surfaces should flatten to an objectionable extent, the renewal of rollers and seats is a simple and comparatively inexpensive operation.

The roller seat at its top side conforms to the shape of the inside of the bolster plates and distributes the load over a

in the same relative position to the truck without being placed above the inclined floor of the car. The centering casting on the car body is integral with the draft gear back stop. The holes receiving the pin fastening together the body and truck center castings, are slotted in order to allow the necessary angular movement between truck and car. There is no normal vertical movement between these two parts.

The center portion of the car, between trucks, has the bottom placed on a line with the bottom of the center sills, thus gaining additional cubic capacity, and slightly lowering the center of gravity.

The cross diaphragms in the car framing become the ends of the depressed bottom. On the outside of the car, short pieces of tie section, the same as the side stakes, are placed so as to come opposite the cross diaphragms and bear against the car dumper blocking, supporting the car at a strong point of reaction. The side stakes and top coping angles serve the same purpose.

The vertical corner angles connecting the side plates of the car with the end plates have the flanges, attached to the end plates, turned out, so that the projecting edge of this flange, together with the edge of the plate riveted to it, will bear against the dumper blocking, thereby helping support the weight of the car and lading and protecting the grab irons from injury. Both the corner push-pole pocket and reinforcing bracket casting, under the center of the body

bolsters, furnish placed for jacking and stooling the car.

The general details of construction can be understood from the drawings.

(*This article will be concluded in the June issue.*)

Annual Report of the Bureau of Explosives

Much interesting data on the handling of hazardous commodities is contained in the annual report of the chief inspector of the Bureau for the Safe Transportation of Explosives and Other Dangerous Articles for the year 1920, which has just been issued. To one unfamiliar with transportation conditions, it would naturally seem that the shipments that would cause the greatest damage would be those containing high explosives. It is interesting to note that the loss per ton for nitric acid and "strike anywhere" matches is considerably greater than for either high explosives or black powder. The greatest losses from any single commodity are those resulting from the transportation of gasoline, due principally to the large volume of the shipments.

The actual total loss for the year 1920 amounted to $1,090,806 for all kinds of dangerous articles. This is a decrease of over half a million dollars compared with the previous year. Nevertheless, the report states that the majority of the 1,977 accidents resulting in this loss should not have happened, as they were due to carelessness or ignorance.

Particular interest attaches to the statistics regarding transportation of gasoline, as the losses due to these shipments are greater than from any other single commodity. The total loss from this cause has been decreasing in recent years. In 1918 it was $900,106; in 1919, $691,635, and in 1920, $351,262. During the past year, special attention has been given to the bottom discharge valve in tank cars, as this has been a prolific source of loss. A summary of accidents chargeable to this part of the tank car shows little or no improvement in the last two years.

A comparison that has not been made in previous reports is shown in a summary of reported losses compared with the total production for several important commodities. The statistics for 1920, which are typical, show that the loss per ton was as follows:

Nitric acid	$1.71
Matches	.51 2/10
Black powder	.19 9/10
Charcoal	.08 7/10
Gasoline	.02
High explosives	.00

In discussing the importance of education, the chief inspector mentioned the good results secured by the organization plan prepared by the bureau for the purpose of interesting and educating railway employees in the regulation, which has been adopted quite generally by the railroads.

The glass carboys in which acids are shipped are not sturdy containers and many accidents are caused by breakage of these vessels. Recently an attempt has been made to prescribe suitable tests for carboys, and this work is outlined in the report.

The review of tank car matters points out that the casualties in gasoline tank car fires were reduced in 1920 to no deaths and 6 injuries, as compared with 2 deaths and 28 injuries in 1919. A review of the work being carried on by the bureau in connection with the A. R. A. tank car committee and the American Petroleum Institute is given. This pertains particularly to improvements in the bottom outlet valve, the dome closure and the safety valve. Special mention is made of experiments now being conducted for the purpose of developing a standard specification for tank cars for muriatic acid.

The concluding section of the report is devoted to a discussion of the detailed work of the bureau. Numerous statistical summaries are given and circulars issued during the year are collected and reprinted.

Saving Money in Car Repairs*

BY A. F. O'BRIEN

Little or no attention has been given to the revenue derived or lost in repairs to freight cars or to the study that is required of the men who have undertaken the task of keeping equipment in safe and serviceable condition. The average railroad man knows practically nothing as to how repairs to cars are handled or how the company is reimbursed for its expenditure in connection with the repairs to foreign equipment, the amount of which involves millions of dollars each year.

The American Railway Association rules must be thoroughly understood by those in charge of the work, and particularly so by the inspector of A. R. A. repair cards, whose duty it is to make up the repair cards in order that each operation may be described in such a way that there can be no question as to the operations performed.

After the repair cards are made up they are passed to the billing department for pricing. The duties of the bill clerk pricing these repair cards are nerve racking. He must read thousands of repair cards made up by hundreds of employees and know just what operation each one is trying to describe. A wrong interpretation of the repair card may mean considerable loss of money to the company. The bills rendered against the company by foreign lines is an item that must be properly checked. The bill clerk should be a practical car man, who knows the construction of equipment, the knowledge of which can only be gained in actual experience in the shop. Such a man is an asset to the company and his value cannot be over-estimated. He can tell at a glance whether the operation described on the foreign line repair card could be performed on a car in any certain series and eliminate such charges as are improper.

The amount of money saved in a year through the elimination of such improper charges may be represented in no less than five figures and this is no doubt also true where small items, such as pin chain clevises, nuts, air hose and numerous other parts are used to repair foreign cars in train yards and on line between stations and not reported. If train crews would realize that every air hose applied on the line between stations on account of being burst and not reported is worth $2.30, which amount should be charged to the car owner, and every knuckle $4.80, knuckle lock $1.95, brake shoe $0.56, etc., there would be an immediate increase in the number of reports of material applied on the road turned in.

Another item that takes its yearly toll in dollars and cents is the improper handling of equipment in yards by switch crews. This is an item that in the majority of cases a little forethought on the part of the men handling the equipment would prevent. A slight rake or the cornering of a car may not seem much to look at, but the cost to repair when figured up, with the present high cost of labor and material, would indeed surprise those responsible.

MAKING BOLTS FIT TIGHT.—Two novel and interesting methods of making a tight fit in bolts subjected to shearing stresses are described in the report of the Bureau of Standards, abstracted in the *Iron Age*. The bureau was requested to devise a method by which bolts could be secured with a tight fit over the entire length. Two methods were tried, both of which gave satisfactory results. In the first case the bolts were finished a little larger than the holes in the plate. They were then immersed in liquid air until they contracted sufficiently to enter the holes quite easily. Upon warming up, the bolts expanded, gripping the plates tightly. In the second method, each bolt was provided with a small hole along its axis and was finished to an easy fit in the plate. After insertion, a charge of powder was exploded in the small hole. This expanded the bolt causing it to grip the plate. Subsequent physical tests indicated that the strength of the joint secured by both methods was sufficiently high for the purpose.

*From the Erie Railroad Magazine.

Repair and Maintenance of Steel Freight Cars*

Necessity for Adequate Shop Facilities and Proper Organization Strongly Emphasized

BY SAMUEL LYNN

Master Car Builder, Pittsburgh & Lake Erie

HEAVIER motive power, with greatly increased train tonnage, has created a demand for cars of increased capacity. The limit of capacity apparently has not yet been reached, since one of the large car companies has, within the year, constructed cars of 120 tons capacity.

While no accurate figures are available, it is estimated that approximately 70 per cent of the two and one-half million freight cars in service in North America are either of all-steel, steel underframe or steel center construction. As this number of cars represents an investment of over three billions of dollars, the importance of keeping them in good repair and in service is self-evident.

Maintenance Badly Neglected

A casual inspection in almost any classification yard will reveal the fact that repairs to steel cars have been badly neglected during the past few years. Large numbers of cars may be seen with floor, hopper and side sheets badly corroded and in many cases rusted and worn entirely through. A close inspection will usually develop the fact that center sills are buckled either in front of, or between the body bolsters. This condition is due either to faulty construction, sills of insufficient area, abuse in service, or neglected maintenance. Conditions existing during the recent world war imposed many hardships upon the railroads generally, making it almost impossible for them to keep the maintenance of their freight equipment up to pre-war standards. Shortage of labor and materials, coupled with the pooling of equipment, had a tendency toward deferred maintenance, which resulted in merely patching up worn-out cars and keeping them in service long after they would have been shopped for rebuilding under a normal maintenance program. The large percentage of home cars on foreign roads resulted in neglect, since proper material for repairs of foreign cars was not generally carried in stock. This resulted in makeshift repairs, most roads doing only enough work on foreign equipment so that it would haul one more load, in the hope that it would carry that one load off the line and never return. The results of this practice are now most evident when cars are being returned to the home roads in large numbers and in almost universal bad order.

The speaker believes that the exterior of steel cars should be kept well painted, as by this process at least one side of the steel is protected against corrosion; in addition to this, well painted equipment is a good advertisement for any road. It is obviously impracticable to attempt painting the interior of open top steel cars, since the commodities usually carried in such cars consist of coal, coke, iron ore, limestone, furnace slag and mill products, which in the process of loading and unloading so badly damage the paint that it would serve no purpose as a protective coating. The interior of steel equipment is where corrosion is the most evident and is probably due to moisture laden with acids from the products of the mines and mills, or to electrolysis caused by impurities existing in the steel itself.

I would like to here state a few things that in my opinion are necessary to maintain steel car equipment properly and economically.

First: Shops should be provided at points where heavy repair steel car work is to be performed. They should be well lighted and ventilated, and in the colder sections of the country should be properly heated. Overhead crane service is desirable, and by proper arrangement eliminates the necessity for material tracks between the working tracks. Small wall or jib cranes should be installed for handling yoke riveters, etc. The money expended for shops will repay the investment many times over in a few years. While I would not say that a steel car cannot be repaired outside under adverse weather conditions, I believe that the work can be carried on more successfully where shops are provided.

Second: Shops should be well equipped with suitable machinery, properly located so that repair parts may be made economically without any lost motion or backward movement. It is a question whether or not it pays to attempt the manufacture of all steel car parts in the average railroad shop. Some of the larger railroads buy most of their car repair parts already punched and pressed into the proper shape ready for application. However, it is necessary to have sufficient machinery to make odd parts or to extend the supply when exhausted, as it is almost impossible to keep sufficient parts on hand to meet all conditions.

Punches, shears, hydraulic presses, heating furnaces, and a good supply of efficient pneumatic tools are indispensable in the modern shop and will soon repay the initial cost of installation. Sufficient compressor capacity with facilities for supplying dry air at all times is necessary for the economical use of pneumatic tools. Proper facilities should also be provided to take care of the scrap parts that will accumulate, and the shop and surroundings should be kept clean at all times. While this may not seem important to some, nevertheless it has a certain moral effect on the workman, which should not be underestimated.

Third: Other facilities must be provided, such as storehouses, storage yards, air brake shops, paint shops, oil houses, etc., depending on the size of the shops. The storehouse or material supply house should be located as near the shops as possible and electric tractor service or other means installed for convenient and economical transportation of materials. Fuel supplies and stores should be under direct supervision of the foremen in charge, or if the shop organization does not permit this, the storekeeper and car foreman should be very close together and work in perfect harmony.

The Importance of Supervision

Fourth: Another and probably one of the most important factors in repairs to steel cars is the quality and quantity of supervision. Sufficient intelligent supervision must be furnished or the work will lag and both the quality and quantity of the output will suffer. The gang foreman who comes into daily personal contact with every man under him is the keystone of any organization. He forms the contact point between the management and the men and when the contact is broken, the current ceases to flow. These men should be selected from the ranks, if possible, and should be men who have developed ability and initiative in their work and they should also have ability to handle the workmen. While a thorough knowledge of how to perform the work is necessary, this is not the first requisite, as ability

*Abstract of a paper read before a meeting of the Canadian Railway Club, March 8, 1921.

to handle men and personality stand above this qualification. Foremen should be intelligent and fairly well educated in order that they may read the rules, blueprints and instructions and apply them intelligently, and also that they may be eligible for promotion to higher positions as vacancies occur. Wages paid foremen should be sufficiently attractive to create an incentive for the men to fit themselves for such positions.

The successful supervisor, in addition to his knowledge of the work, should show loyalty toward his employer, have the courage to enforce discipline, insist on and obtain a fair day's work from every man in the service, and be absolutely impartial in handling his men in order to obtain and hold their co-operation and respect. He should also have the vision and ability necessary to discover trouble makers and weed them out before the remainder of the organization becomes contaminated. No man should be placed in the position of foreman unless the appointing officer feels that the man selected is capable of developing the necessary initiative and ability to accept any position up to the top of the shop organization, as those men selected for the bottom round of the ladder should be capable of advancing step by step until they reach the top. Most higher supervisory officers have not the time to mingle with the workmen and they must depend on their foremen to provide the little touches of personality and co-operation that are the life of any organization.

Fifth: Another important feature is the personnel of the shops. Wages paid and working conditions should be such that they will attract capable young men to seek employment in railroad shops. Unless this is done, there is a tendency for skilled mechanics to seek more remunerative employment in industrial work. This is particularly true in the large industrial centers. The tendency prior to federal control in some sections of the country, due to shortage of mechanics and inability to induce young men to enter the service, has been to hire foreigners from central and southern Europe, men who have never had any mechanical training, and to try to make mechanics out of them. These men come to us wholly unacquainted with our language, our customs, and our laws, and must be assimilated into our organizations. While at first a rather costly proposition, with proper and tactful handling they usually learn rapidly, and have become the mainstay of some of our car shop organizations. It is important that those charged with the handling of these men, should by careful and tactful treatment instill in them the principle of loyalty to their employers; with proper encouragement and fair dealing on the part of their foreman the majority of these men readily become acquainted with our methods of work. The nationalization of foreigners has become important and it is very generally conceded that they are more easily reached in the shops that in their homes. However, any tendency toward radicalism should be carefully watched and immediate steps taken to circumvent it.

The only commodity a railroad has to sell is transportation. Anything that tends to increase the quantity or speed of transportation is a distinct addition to the wealth and resources of the country. Good, efficient motive power may be essential, but without freight cars the railroads would have little use for locomotives. Estimating that four per cent of all the cars in the country are shopped, every day of unnecessary delay in returning them to service represents a per diem loss to the railroads of approximately $100,000. The importance of providing adequate shop facilities is self-evident.

Suggestion as to Repairs

In the actual work of repairs it is suggested that draft attachments and center construction be sufficiently strengthened so that the shocks incident to modern service will be absorbed and distributed throughout the car, without causing extensive damage to the superstructure. Center and draft sills should have sufficient area and should be protected against buckling by the use of cover plates. A common cause of failure is due to bodies of hopper cars not being securely fastened to center sills. A few rivets are driven in inside hopper sheets to hold the body to the sills, and the heads corrode and wear off, allowing the rivets to pull through the sheets. This results in the whole strain being thrown on the body bolsters, which are usually of a wide single plate type, with the result that they are unable to stand up under the strain. The sills start moving back and forth under the car and it soon gets in such condition that permanent repairs become a rather expensive proposition. Sides and ends of steel equipment should be properly re-enforced to prevent bulging out under load. Drop door equipment should be kept in proper working order to facilitate unloading. Care should be taken in repairing trucks to provide side bearing clearance and to see that brakes and all running gear are kept in good condition.

A well defined program of re-enforcement should be outlined and put into practice on all roads. The cost of such additions and betterments is usually insignificant when the future life and productive service of the car is considered. Money appropriated for such features is a good, sound investment when judiciously used, and should pay large dividends. Many roads make the mistake of repairing their older equipment in kind as they do not have exacting conditions on their lines. Such equipment should either be re-enforced or kept on their own lines and not offered in interchange, where there is a possibility of it getting out into the large industrial centers and in heavy tonnage trains, when it is almost an impossibility to keep it off the repair tracks.

This places an unnecessary burden of expense on both the owner and the handling line. As cars come into the shop for general repairs, a careful inspection should be made, and if the car has not deteriorated to the extent that it is felt advisable to scrap it, it should be repaired in accordance with a well defined re-enforcement program, as outlined. Otherwise, if this is not done, after considerable money has been spent on the car, due to inherent weakness, it will again be back on the shop track.

In conclusion, if the railroads were provided with the facilities and a maintenance program similar to that suggested in the paper was adopted by all roads, and an honest effort was made to maintain the cars in accordance with that program, the steel cars in the country would give the owners a better return for the money invested in the way of better service and in increased life of the cars.

Discussion

There were about 500 in attendance at the meeting; the discussion lasted two hours and had to be cut off because of the lateness of the hour. It was opened by Vice-President Grant Hall of the Canadian Pacific and Vice-President W. D. Robb of the Grand Trunk. A large number of visitors were present from the "States."

In general the discussion indicated that there were few roads owning steel cars which had adequate shops or facilities for taking care of them. The problem has been greatly complicated in the United States by the return of badly deteriorated cars to the home roads at the end of federal control. One road converted an old roundhouse and an old storehouse into steel car repair shops by equipping each of them with facilities and tools costing about $70,000. Five heavy repairs per day are now being turned out of each of these plants.

The metal used in steel cars was seriously criticised because of the rapid rate at which it deteriorates. It was suggested that a better steel be used, similar in composition to the iron used in the Baltimore & Ohio box cars which

were built in 1862, the bodies of some of which are still in existence and have not suffered to any extent from rust and corrosion.

Heavier motive power and careless switching of cars has been responsible in part at least for the failure of some of the earlier designs of steel freight cars.

What is needed more than anything else is a systematic program for making heavy repairs to freight cars so that a certain percentage of the equipment will be given such repairs each year—this percentage to be based upon the number of years which a car can safely run between heavy repairs. Locomotives are shopped on a mileage basis. Why not establish a reasonable and scientific basis upon which to shop freight cars and then see that it is lived up to? This will keep the equipment in prime condition and at a minimum of expense after the program has been well established. It will be necessary to speed it up for some time, however, in order to catch up with the deferred maintenance.

Draft Gear Tests of the Railroad Administration

Results from Gears After Three Years' Service; Destructive Tests and Rivet Shearing Tests

THE results of the tests with friction surfaces coated with foreign matter indicate that while new gears in laboratory tests may show acceptable capacities, depreciation may occur in service, not only from eventual wear, but from an immediate coating of the friction surfaces.

It has not been possible to investigate this as thoroughly as desired, but some little work of this character has been done in conjunction with the engineer of tests of the Norfolk & Western Railway. Experiments were made upon five different types of gears which had been in service for approximately three years each on N. & W. 100-ton coal cars. The gears were carefully removed from the cars so as not to disturb the deposit and glazing on the friction surfaces and were put in tight, individual boxes and carried immediately to the drop test machine.

The actual fall required to close the gears in their service condition was determined in as few blows as possible, after which a building up or restoration test was made by giving the gear additional blows until no further increase in capacity could be obtained. No attempt was made to clean the surfaces of these gears prior to the building up tests, as the test was intended to develop what recovery might be effected by simply working the gear. The gears were all in good condition as to wear, and would in every instance have been so declared upon surface inspection. The results of these tests are shown in Table IV.

TABLE IV—DROP TESTS OF FRICTION GEARS WHICH WERE TAKEN OUT OF SERVICE, NORFOLK & WESTERN RAILWAY

		Average results—9,000 lb. drop			
Make and type of gear	Number of gears tested	Drop test value of new gear total fall, in.	Total fall required to close gears when first removed, in.	Gear restored to—total fall, in	Number of blows necessary for restoration
1	2	3	4	5	6
Miner, A-18-A	10	19.9	16.4	17.5	18
Miner, A-59	2	27.0	18.0	20.5	32
Sessions, K	2	19.3	8.6	9.0	14
Sessions, Jumbo	2	28.1	15.0	16.5	21
National, H-1	10	31.2	19.4	26.9	32

In explanation, the Miner A-18-A gear is the same as the Miner A-18-S of the U.S.R.A. tests, except that the A-18-A has 3 in. travel and the A-18-S has 2½ in. travel. The Miner A-59 gear is an especially long gear, not usable in the standard pocket and hence not included in the U.S.R.A. tests. The Sessions K, the Sessions Jumbo, and the National H-1 are identical with the same types of draft gear in the U.S.R.A. tests.

Column 3 gives for ready reference the total average drop test value of the several types, when new and in good condition, as found in the U.S.R.A. tests. The Miner A-18-A is taken the same as the A-18-S. For the Miner A-59 a value is taken from previous tests of these gears.

Column 4 gives the average total fall, including the travel, required to just close the gears when first tested after removal from service. These figures therefore represent the value of the gear as in actual service, after a period of three years' use, as heretofore explained.

In this test the Sessions gears, which have the friction elements of unhardened cast iron working against unhardened forged steel, showed the greatest percentage of depreciation and the least restoration. The National gear, which has hardened steel friction elements working together, showed the next greatest percentage of depreciation and the greatest restoration. The Miner gears, which have hardened steel friction shoes working against a malleable iron barrel, showed the least percentage of depreciation and necessarily the least percentage of restoration. It does not thus appear that the character, and particularly the hardness of the friction surfaces, influenced this depreciation. On the other hand, the Miner gears were under a heavy initial compression in the cars and the Sessions and National were under practically none.

It is therefore probable that the tightness of the friction parts may have prevented the entry of the foreign material in the case of the Miner gears. In the case of these N. & W. gears, the friction shoes in the Miner gears were in every instance tight with the gears in position in the cars, while the friction members were loose in every one of the Sessions and National gears. As no measurable wear had occurred in the National gears the manufacturers offer in explanation of this loose condition of the friction members that an inferior lot of springs had been used, with consequent set and loosening of the friction parts in the car. In the case of the Sessions gears the designs provide for loose friction blocks in the car. Further investigation along the lines of gear depreciation, due to foreign material on the friction surfaces in service, should be made.

Destructive Tests

Immediately after the tests with coated friction surfaces, the same gears, one of each of the types included in the program, were tested to at least partial destruction under the 9,000 lb. drop, the gears being supported on a solid anvil. In each instance successive blows were given from heights beginning at 1 in. free fall of the weight and increasing by 1 in. increments, a record being made of the point at which each gear went solid and of the point at which destruction began, as evidenced by scaling, fracture, bending or shortening of some part of the gear. These tests are of the kind best suited to show the ability of a gear to receive over-solid blows and are designed to penalize weakness instead of putting a premium upon it, as set forth in a preceding chapter of this report. It will be noticed that some of the gears begin to

show evidence of distress at a fall of just a few inches above the solid point.

Summary of Destructive Tests

The table No. V has been prepared to show the results of these tests and to grade the gears as to destructive value. It is quite possible that a repetition of lighter blows would in each instance have produced failure, but it is believed that no great error is made by this comparative grading.

Column 3 gives the total fall required to close the gears during this particular test. In some instances this varies slightly from the figure obtained in the original drop tests, due usually to the fact that some of the gears could not be fully restored in the immediately preceding tests with coated friction surfaces.

TABLE V—PERFORMANCE OF GEARS IN DESTRUCTIVE TESTS

Make and Type of Gear	Test Gear No.	9,000 lb. weight: Total fall required to close gear in this test	9,000 lb. weight: Additional fall beyond closing point required to start failure	Development of failure	Average total fall 9,000 lb. weight required to close one commercial gear of this type, Inches	Destructive value assigned to this type of gear, Inches fall
1	2	3	4	5	6	7
Westinghouse D-3	1	18.5	4	Rapid	19.8	23.8
Westinghouse NA-1	6	27.0	4	Rapid	26.0	30.0
Sessions K	10	15.2	2	Rapid	18.8	19.8
Sessions Jumbo	13	24.1	4	Slow	28.1	32.1
Cardwell G-25-A	16	20.8	2	Rapid	18.9	20.9
Cardwell G-18-A	19	20.3	3	Rapid	19.6	22.6
Miner A-18-S	22	16.5	7	Medium	19.9	26.9
Miner A-2-S	25	12.5	7	Medium	13.2	20.2
National H-1	28	33.5	17	Slow	31.2	48.2
National M-1	31	19.5	10	Slow	19.2	29.2
National M-4	34	19.5	6	Slow	21.5	27.5
Murray H-25	37	17.7	5	Medium	17.0	22.0
Gould 175	40	17.4	4	Medium	18.1	22.1
Bradford K	45	11.5	1	Rapid	10.8	11.8
Waugh Plate	48	12.2	2	Slow	13.9	15.9
Christy	51	14.3	8	Slow	19.6	27.6
Harvey 2-8 in. by 8 in. springs	54	7.9	5	Melium	9.5	14.5
Coil springs 2-8 in. by 8 in. Class G	57	5.8	2	Rapid	5.8	7.8

Column 4 gives the additional height from which the 9,000 lb. weight was dropped, reaching this by increments of 1 in. from the solid point, before visible distress of the gears began.

Column 5 has been inserted to denote whether the failure from this point on developed slowly or rapidly, under constantly increasing falls.

Column 6 gives for reference the figure accepted as the average total fall required to close a new commercial gear of this type, when in good condition, this column being the same as Column 10, Fig. 16.

Column 7 gives the comparative destructive values assigned the several types. This figure is obtained by adding to the average drop test value of the type of gear as given in Column 6, the over-solid values in Column 4. Thus in the case of the Westinghouse D-3, gear No. 1 of this type was subjected to this test. During the test gear No. 1 went solid at a total fall of 18½ in. and at a total fall of 22½ in., or 4 in. above the solid point, the barrel started to fail. Accordingly the destructive value of this gear has been set by adding 4 in. to the average total fall figure 19.8 in., giving a destructive value of 23.8 in. The same practice has been followed for all gears.

Rivet Shearing Tests

The draft gears for the U.S.R.A. cars were purchased on the requirement that they be of "150,000 lb. capacity" and the Mechanical Committee later defined a 150,000 lb. capacity draft gear in the following words:

"A 150,000 lb. draft gear should be defined as one that will sustain a drop of 16 in. (including travel of gear) of a 9,000 lb. weight, without shearing the rivets of one or both lugs, which are to be secured to suitable supporting members by nine ½ in. rivets of .15 carbon or under, driven in 9/16 in. holes."

A representative number of gears of each type used on U.S.R.A. cars were selected at random and subjected to the above test. The average of the results for each type was used to determine whether or not that type of gear met the terms of the specifications. In these tests the gears were supported upon a solid anvil and the weight was dropped from successive heights, increasing by 1 in. increments until the rivets sheared.

In testing the Sessions K gears, the highest capacity gears sheared the rivets at a lower drop than the lower capacity

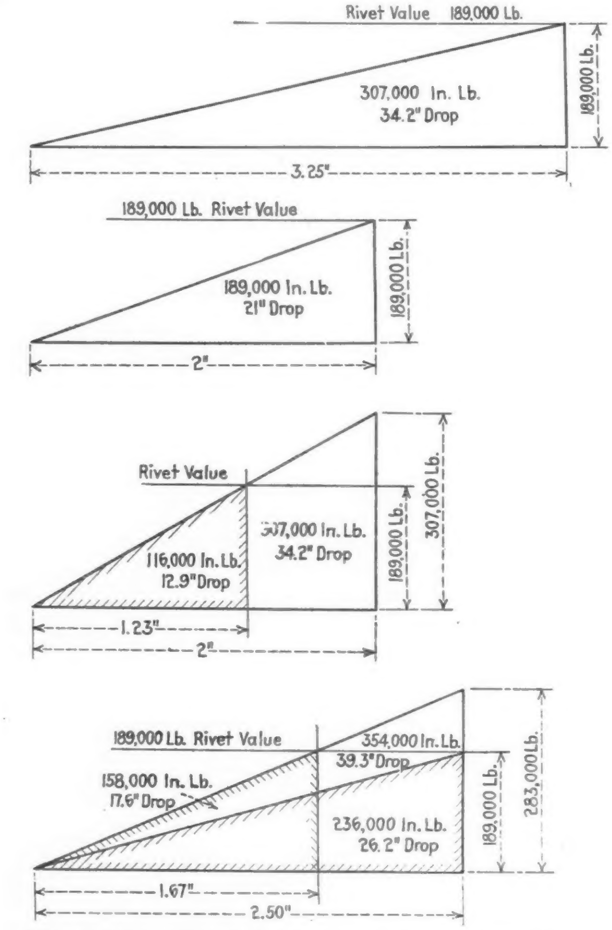


Fig. 3—Diagrams of Rivet Shearing Action of Draft Gears

gears. In five instances the rivets sheared before the solid point of the gear was reached. In three instances the rivets sheared at the point of gear closure; and in but two instances did it require a blow from above the solid point to shear the rivets. In three instances the rivets were sheared at a point below the specification requirement when the successive blows by 1 in. increments were given the rivets. In each of the cases, however, when the gear was again set up and a single blow given from a height sufficient to produce a total fall of 16 in. the rivets did not shear. Thus, one of these gears, when given blows increasing by 1 in. increments, sheared the rivets at a total fall of 11 in., and when it was immediately thereafter given a single blow from a total fall of 16 in. the rivets were not sheared. The rivets in this re-test sheared at the next blow, or at a total fall of 17.2 in.

For the Sessions gears it required on the average 2.7 in. less fall to shear the rivets than to close the gears. In the

Westinghouse D-3 gears the rivets usually sheared 1 in. above the solid point, although in a few instances it required an over-solid blow of 2 in. to produce shear. In the Cardwell G-25-A gears it required on the average an over-solid blow of 3.2 in. to shear the rivets. In one instance a 4 in. over-solid blow was necessary. In the Murray H-25 gears it required an average over-solid blow of 2.4 in. to shear the rivets.

Considering the Westinghouse, Cardwell and Murray gears, it will be noted that the number of over-solid blows required to shear the rivets is in inverse relation to the over-solid sturdiness or destructive value of the gears as given in Table V. The short travel of the Sessions K gear necessitates a higher ultimate resistance, so that the elastic limit of the ½ in. rivets is passed before the gear goes solid. In considering this test it should be remembered that the eighteen ½ in. rivets (9/16 in. when driven) have a shearing area of 4.47 sq. in., giving an ultimate shearing value of approximately 189,000 lb., with an elastic limit in shear of approximately 135,000 lb. In practice the rear draft lugs each have twelve ⅞ in. rivets in 15/16 in. diameter holes, or a shearing area of 16.57 sq. in., with an ultimate shearing value of 700,000 lb., or an elastic shearing limit of 500,000 lb.

Table VI has been prepared to show the results of these ½ in. rivet shearing tests made for the acceptance of gears for U.S.R.A. cars.

TABLE VI—RESULTS OF ½-IN. RIVET SHEARING TESTS. DRAFT GEARS FOR U. S. R. A. CARS 9,000-LB. DROP

9,000-*Lb. Drop*

Make and type of gear	Number of gears tested	Total fall to close gear, inches			Total fall to shear rivets, inches		
		Maximum	Minimum	Average	Maximum	Minimum	Average
1	2	3	4	5	6	7	8
Westinghouse D-3..	18	21.6	18.6	19.9	22.6	19.6	21.0
Sessions K	10	23.1	18.1	20.5	22.1	11.0	17.8
Cardwell G-25-A....	5	17.6	15.6	16.6	20.6	19.5	19.8
Murray H-25.......	7	17.8	16.8	17.6	20.8	17.8	20.0

In order to show for comparison how all of the gears perform in this test, and in order to study the specifications in the light of a full knowledge of each particular gear, one of each type of gear in the tests was subjected to the ½ in. rivet shearing test. This was done after the car-impact tests and was the final test given the gears.

The results are given in Table VII, the several columns of which are described as follows:

TABLE VII—PERFORMANCE OF GEARS IN ½-IN. RIVET SHEARING TESTS

Type and make of gear	Test gear number	Total fall required to close this gear solid anvil. Inches	Free fall required to shear rivets, Inches	Travel of gear when rivets sheared, Inches	Total fall required to shear rivets, Inches	One or both lugs sheared
1	2	3	4	5	6	7
Westinghouse D-3..................	2	19.50	17	2.47	19.5	one
Westinghouse NA-1................	7	26.00	21	2.66	23.7	both
Sessions K..........................	11	20.06	11	1.45	12.5	one
Sessions Jumbo....................	14	27.06	14	2.10	16.1	both
Cardwell G-25-A..................	17	20.75	20	2.75	22.8	one
Cardwell G-18-A..................	20	18.29	18	3.29	21.3	one
Miner A-18-S......................	23	19.52	17	2.47	19.5	one
Miner A-2-S........................	26	13.53	11	2.53	13.5	one
National H-1......................	29	32.50	9	1.00	10.0	one
National M-1......................	32	18.53	17	2.53	19.5	one
National M-4......................	35	23.46	17	2.30	19.3	both
Murray H-25.......................	38	16.47	16	2.47	18.5	both
Gould 175..........................	41	17.44	16	2.44	18.4	both
Bradford K.........................	46	8.44	8	2.44	10.4	one
Waugh Plate.......................	49	13.25	11	2.25	13.3	one
Christy	52	18.21	12	1.95	14.0	one
Harvey 2-8 in. by 8 in. springs....	55	10.76	8	1.76	9.8	one
Coil springs 2-8 in. by 8 in., Class G.	58	5.70	7	1.70	8.7	one
Solid steel block..................	..	...	4	...	4.0	....

Column 3 gives the original total fall required to close each gear. During this test care was taken to see that all gears were up to this original capacity.

Column 4 gives the free fall required to shear the rivets of one or both lugs. This height of fall was reached through successive blows increasing by 1 in. increments.

Column 5 gives the actual amount of gear closure obtained in this test with the free fall of Column 4.

Column 6 gives the total fall required to shear the rivets, this being the sum of the quantities in Columns 4 and 5.

Column 7 denotes whether one or both lugs sheared, this, however, being of secondary interest.

In each of these tests the rivet samples were analyzed and the carbon content in no instance exceeded .15, the usual average ranging from .09 to .12.

Some of these results will, at first thought, appear inconsistent, but a more careful study will show that the results in general are approximately what should be expected when gears of different travels and capacities are tested upon undersized rivets. Thus the gears generally may be divided into two classes: those closing at four miles per hour or more in the car-impact tests and those closing at less than four miles per hour. Seven types as follows fall in the higher class:

National H-1.
National M-1.
National M-4.
Miner A-18-S.
Westinghouse NA-1.
Sessions Jumbo.
Sessions K.

It will be noted that in no case did a gear of this class require an over-solid blow to shear the ½ in. rivets. In six cases the rivets sheared before the gears went solid and in the remaining case the rivets sheared at the solid point. Furthermore, as might be expected, the gears of short travel usually sheared the rivets earlier than those of equal capacities and longer travel.

A more clear understanding of this action will be had from the diagrams of Fig. 3. At the top of this figure is shown a straight line diagram of a gear of 34.2 in. drop capacity and of 3¼ in. travel. The ultimate resistance of this gear is 189,000 lb. and the eighteen ½ in. rivets should shear at the same value, or just when the gear goes solid. Next there is shown a diagram of a 2 in. travel gear of the same ultimate resistance, 189,000 lb., and with this gear also the rivets should just shear at the solid point, but which in this case would be at 21 in. drop instead of 34.2 in. Next is shown the diagram of a gear of 2 in. travel but of the same capacity (34.2 in. drop) as the 3¼ in. travel gear at the top of the figure. The ultimate resistance of the gear would in this case be 307,000 lb. and the rivets, which have the value of 189,000 lb., should shear at 1.23 in. gear travel or at a drop of but 12.9 in. This gear, therefore, which is of the identical capacity as the 3¼ in. travel gear, will shear the rivets at 12.9 in. drop, whereas the 3¼ in. travel gear will require 34.2 in. drop. This increase in drop is due solely to the increased travel of the gear with consequent decrease in ultimate resistance. At the bottom of Fig. 41 are shown superimposed diagrams of two gears, each of 2½ in. travel, but the one of 26.2 in. drop capacity and the other 39.3 in. drop capacity, or just 50 per cent increase. In the case of the lighter capacity gear the rivets do not shear until the gear goes solid or at 26.2 in. fall. In the case of the larger capacity gear the rivets would shear at 17.6 in. drop. Here is shown how by simply increasing the capacity of the gear 50 per cent the ½ in. rivets are caused to shear 13.1 in. lower than with the lighter capacity gear. These conditions are for straight line gears and for shearing the rivets at a single blow. When a succession of blows is given from varying heights the difference becomes even more marked, as a heavier capacity gear begins to punish and permanently deform the light rivets early in the test.

The above principles are reflected in the test results. Thus

the Sessions K gear and the Cardwell G-25-A were of practically equal drop test capacity but different travels, namely, 2 1/16 in. and 2¾ in. respectively. The Sessions K gear (2 1/16 in. travel) sheared the rivets at 12.5 in., while the Cardwell (2¾ in. travel) sheared them at 22.8 in. Again, the National H-1 gear sheared the rivets at 10 in. fall, while the National M-1 gear sheared them at 19.5 in. fall. Here the travels of the gears are the same, but one gear had a drop test capacity of 32.5 in., while the other had 18.5 in.

An effort was also made to test all the gears on full-sized rivets, a total of twenty-four ⅞ in. rivets (16.57 sq. in.) being used for the two lugs. The three gears tested in this way failed which showed the futility of attempting to use this method of testing. From this experience and from careful study, it is believed the present ½ in. rivet shearing test is not a fair method of grading gears. Car sills are designed for a load of 500,000 lb. and it therefore should not be expected to hold the draft gear to the limits required by this light test. It is believed possible, however, to develop a rivet shear test to grade gears of all capacities, and investigations have been outlined to develop a test of this character. In this work the following points will be established or disproved:

1. That rivet shearing tests should be designed to show smoothness of action and the ultimate dynamic resistance.
2. That such tests should not be carried beyond the solid point of the gear, because of the fact that all gears are not of equal rigidity when solid.
3. That the rivets should be of such area that a single blow may be given from a stated height, within the capacity of the gear, and the rivets not be sheared.
4. That the rivets should shear at a blow from not more than a stated height above the solid point; this in order to penalize over-solid weakness of construction.
5. That the tup should not be dropped through successive heights increasing by 1 in. increments because of passing the elastic shearing limit of the rivets before the gear is solid, but that the gear should be set up on lugs or the equivalent and a single blow given from a specified height for that particular gear and the rivets not be sheared. Using a new set of lugs, another single blow should be given from a second specified height at which the rivets should shear.
6. That the number of rivets used and the heights of drop should not be the same for all gears but should be set for each type in accordance with its capacity and travel.
7. That the rivet area and height of fall should be determined by the drop test capacity and travel of the gear.
8. That the test rivets should be of high carbon steel or other material having a high elastic shearing limit; this in order to avoid the uncertainty of the exact shearing point.
9. That when all gears are constructed of equal travel the question of rivet shearing tests will be greatly simplified.

Car Inspectors Propose Change in Interchange Rules

Suggestions Largely Intended to Remove Conflicts and to Effect Uniformity of Application

In the April issue of the *Railway Mechanical Engineer,* page 233, appeared the first installment of the transcript of the proceedings of an open meeting of the executive committee of the Chief Interchange Car Inspectors' and Car Foremen's Association of America, held at the Hotel Sherman, Chicago, on March 3 and 4, 1921, for the purpose of recommending changes in the Rules of Interchange. The following is a continuation of the discussion which took place at that meeting.

At the opening of the session on March 4, attention was called to the fact that Henry Boutet, one of the founders of the Association and chief interchange inspector at Cincinnati, Ohio, was unable to be present on account of serious illness, and the secretary was instructed to express to him in suitable manner the sympathy of the members present.

Proposed Change in Rule 4

M. E. Fitzgerald: I move the following change in Rule 4:

Eliminate from the fourth paragraph of Rule 4, the words "with the exception of the cases provided for in Rules 56, 57 and 70."

Rule 56 pertains to cars intended to be equipped with metal brake beams and so stenciled if found with wooden brake beams. Rule 57 has to do with cars not equipped with A. R. A. standard 1⅜" air brake hose, and Rule 70 deals with steel wheels. It is absurd to permit the owners of equipment to hold you responsible for wrong repairs to steel wheels, when they will not give owners who have cars equipped with more expensive devices similar protection. The case of the brake beams is fully taken care of and if an intermediate line repairs a car with wooden brake beams under it, they may bill the owner. If the car is stenciled the owner must use his repair cards as joint evidence. In the case of the wheels we have a recent arbitration decision. This is a defect that cannot be detected at night and the handling line, that did not make the repairs, is heavily penalized when it should not be.

Chairman Gainey: I do not agree that those defects cannot be detected at night. If a man cannot detect a cast iron wheel from a steel wheel, we might as well quit inspecting at night.

M. E. Fitzgerald: Cast steel wheels are overlooked because the stenciling is bad. In many cases owners are putting them in and permitting the cars to run and the handling lines are being heavily penalized. You have a car equipped with steel sills and you pull them out and put in wooden timbers. The only redress the owner has is joint evidence. There is as much money involved as in steel wheels; why shouldn't the man with the steel wheels do the same thing?

The motion was seconded and carried.

Mr. Pellien's motion was carried.

Change in Preface

F. H. Hanson: I would like to make recommendations for a change in preface of these rules. The first paragraph reads as follows:

These rules make car owners responsible for, and therefore chargeable with, repairs to their cars, *except as otherwise provided.*

I move that the words "except as otherwise provided" be stricken from the rules for the reason that they are nothing but a loophole giving various roads a chance to deviate from the M. C. B. rules. If we are going to have rules, let us make them so they can be lived up to in one part of the country as well as in another part of the country. Recently we had an agreement under consideration and when I took it up with the other party as to why they wanted certain paragraphs in the agreement, when I thought all that was necessary was to say that the interchange would be handled in accordance with interchange rules, they called

attention to the preface saying "except as otherwise provided" and said that they expected to take advantage of those words.

The motion was seconded.

F. W. Trapnell. "Except as otherwise provided" refers to Rules 32, 48 and 49.

C. M. Hitch: How can any interchange association or any other body make a local agreement?

F. W. Trapnell: I do not know of any local agreements running in the country today with any interchange associations except as to costs. There is a provision in the transfer rule whereby the A. R. A. says "unless otherwise provided." That is merely a matter of otherwise providing for the collecting of the cost of the transfer.

C. J. Wymer: Automatically this abrogates all of the penalty rules. I do not like to be quite so radical.

A. Herbster: Could that not be taken care of by making it read "Except as otherwise provided in these rules"?

F. H. Hanson: I did not mean to take out the responsibility contained in Rule 32. I would like to see the rules so worded as to still keep in effect Rule 32 as far as wrecks, derailments, etc., are concerned, without allowing any road to draw up any agreement that will conflict with the A. R. A. Rules.

The motion was lost.

Rule 9

M. E. Fitzgerald: I move that a reference be put in Rule 9, page 28, that repairing lines must state the type of triple valve when stenciled on the car, or not stenciled.

The motion was seconded and carried.

Rule 14

F. W. Trapnell: Under Rule 14, second paragraph, it says:

Facing the B end of car, in their order on the right side of car, wheels, journal boxes and contained parts shall be known as R1, R2, R3 and R4, and similarly those on the left side of car shall be known as L1, L2, L3 and L4.

I move that the side of a car be from corner post to corner post on the right side, and from corner post to corner post on the left side in accordance with this rule.

The motion was seconded and carried.

Rule 17

F. H. Hanson: Referring to paragraph I, second paragraph, Rule 17, which reads:

Cotter keys are not to be applied to knuckle pins of couplers on cars other than hopper and fixed-end gondolas.

I move that it be changed to read:

Cotter keys to be applied to knuckle pins of couplers on all open top equipment except flat cars.

Practically all open top equipment is used in dumping machines.

The motion was seconded and carried.

M. E. Fitzgerald (C. & E. I.): I do not recall having heard any discussion on Rule 3. There is confliction between Rule 2 and Rule 3. For instance, Rule 3 says that cars will not be accepted in interchange unless equipped with all metal brake beams. What should you do with the car under load? Rule 2 says loaded cars must be accepted, and it specifies certain exceptions, which are not those in Rule 3. I move that it is the opinion of this Association that the reference in Rule 3 covers loaded or empty cars.

Secretary Elliott: What paragraph?

M. E. Fitzgerald: All of them. I merely called your attention to one. If the car is offered to you loaded and you accept it and run it and again load it, you never get to the point where the correction called for in Rule 3 is made. You should make the delivering line apply the metal brake beams before they offer the car, either loaded or empty. The rule merely says "Car."

The motion was seconded.

J. J. O'Brien: Do I understand Mr. Fitzgerald's motion to mean that he desires to stop the movement of traffic on loaded equipment simply because the car has wooden brake beams? I do not think we want to go on record as interfering with the loaded equipment. Rule 2 specifically states that loaded cars shall not be rejected. On empty cars it is different.

M. E. Fitzgerald: Rule 2 says that loaded cars must be accepted with certain exceptions. Rule 3 states plainly that cars will not be accepted in interchange unless equipped with all-metal brake beams, and several other items. What is the inspector going to do? I want the rule written so he is clear on it. The items I refer to are minor repairs,—brake beams and hooks on refrigerator cars to hold the doors open,—and when that rule was made it was the intention to enforce the application of those standards. If you permit the car to move and I accept it under load and run it with the wooden brake beams, I unload it, load it again and permit it to run with those brake beams and the other fellow has to take it. You will eliminate the necessity for the rule if you enforce it as the Association intended. Tie the car up and make the road with the car in its possession apply those standard features; that was the object of the rule.

C. J. Wymer (C. & E. I.): If this is intended to apply to empty or loaded cars, it ought to say so; it is in contradiction to Rule 2. If it only applies to empty cars, it should say so and remove that conflict.

The motion was carried.

F. H. Hanson (N. Y. C.): Rule 18, page 37, reads:

When A. R. A. couplers of another make are applied to a car, the uncoupling arrangement shall be made operative at the expense of the company making the repairs.

I move that the following be added to that paragraph:

except when applying Type D couplers in place of old style couplers.

In that event the expense for applying the uncoupling attachments should be borne by the car owner.

The motion was seconded and carried.

Mr. Jameson (Southern): The second paragraph of Rule 22 reads in part:

Longitudinal sills (intermediate or side sills) may be spliced at both ends, on either side of body bolster.

A strict interpretation means that you cannot splice center sills except at one end of the car. Should it not read:

Longitudinal sills may be spliced at both ends.

C. J. Wymer: The rule says "Longitudinal sills (intermediate or side sills)". That tells you what is meant by longitudinal sills. It confines the rule to intermediate and side sills, otherwise there would be no need for the parenthesis.

P. M. Kilroy (St. Louis-South Western): It seems to me that is put in to meet the point raised. It is enclosed in parenthesis to make it clear that you can do exactly what he says you cannot do.

M. E. Fitzgerald: As I read that rule, if you want to find out about splicing sills on either end you would read, "Longitudinal sills may be spliced at both ends," then, "intermediate or side sills on either side of the body bolster." Then find out what you can do with the center sills. The intermediate and side sills may be spliced on either side. The rule is clear and you can splice all longitudinal sills on both ends.

Mr. Jameson: I agree that is what the rule meant to convey, but it does not so state.

A. Herbster (N. Y. C.): Shouldn't the correction be in the second paragraph on page 40, which deals with the splicing of center sills?

Mr. Jameson: I move that we amend this by making it read:

Longitudinal sills may be spliced at both ends. Intermediate or side sills on either side of body bolster.

The motion was seconded and carried.

C. M. Hitch (B. & O.): Referring to Rule 23, I under-

stand there was quite a discussion not long since by a body of car men as to what portion of a cast steel truck side comprised what is termed the "tension member." I would like to ask the views of this body on that question.

W. K. Gonnerman (B. & O.): I have always considered the lower part the tension member and the upper part the compression member.

H. W. L. Porth (Swift & Co.): From an engineering viewpoint there are only two pieces of truck side frame that are tension members and those are the columns. The forces that take place in the so-called bottom cord are alternating; they may be either compression or tension. That has been demonstrated in tests at Purdue University and also in tests made at the University of Illinois.

P. M. Kilroy: It is true that from an engineering standpoint the columns are the true tension members, but there is also considerable tension between the oil box and the column in the bottom member, it may be alternating just as Mr. Porth says—but I think it would be perfectly clear to say that the top member was in compression and the bottom one in tension.

M. E. Fitzgerald: If that is a fact, the prints submitted by the A. R. A. are improperly marked.

H. W. L. Porth: That is the exact reason why the Committee on Welding marked the prints as they did,—from the tests that have been made at Purdue and Illinois. They found that these alternating stresses are in the members of the so-called bottom chord between oil boxes.

C. M. Hitch: That answers my question in a way, but I believe the bottom member of the cast steel truck side is termed the "tension member" and I believe that was the portion of the truck side it was intended should not be welded, for the reason that most of the trouble is in this member. I consider it a dangerous practice to attempt to weld it.

Inasmuch as it has been discussed by other bodies as well as here today, I move that this body ask the Arbitration Committee for an interpretation as to what portion of the cast steel truck side frame constitutes the tension member and what constitutes the compression member. *The motion was seconded.*

E. H. Mattingley (B. & O., C. T.): I would like to request Mr. Hitch to include in his motion that a foot-note be added stating that this refers to bottom members only. I do not believe, gentlemen, that there are any car men handling the repairing of cars today who do not consider the bottom member of the truck side frame as the tension member. You may talk about your engineering features, etc., but it practically replaces with a later modern device the arch bar, as the gentleman illustrated. The Arbitration Committee and the Welding Committee had in mind, as I understand it, that the bottom member of the side truck frame should not be welded.

Mr. Mattingley's suggestion was included in the motion.

M. E. Fitzgerald: If this goes into effect, hundreds of cars already welded will be refused in interchange as not complying with the rules. Some exceptions will have to be made as to dates of welding, excepting those previously welded on authority of the Association's prints.

C. M. Hitch: If this is submitted to the Arbitration Committee it will go to the proper place to be determined. It should be determined because car men are in doubt as to its meaning throughout the country.

The motion was carried.

Mr. Pellien (Ass't. C. I. I., Buffalo, N. Y.): Under Rule 32 I would like to insert a new paragraph. Call it paragraph (O):

Damage to any car if caused by clam shell or bucket in loading or unloading.

Many cars are being damaged in this manner at industrial plants, which damage cannot be termed other than unfair handling and is not protected by the present rules. We are having a number of those cases in the Buffalo district and we feel that Rule 32 is not explicit enough to place the responsibility with the delivering line.

I move that this change be recommended.

The motion was seconded and carried.

M. W. Halbert (Chief Inspector, St. Louis, Mo.): I move that the first paragraph of Rule 32 be changed to read as follows:

Dome covers, safety valves or outlet caps missing from tank cars.

It is felt that the importance of the outlet cap should be so generally recognized that the attention given it would make it next to impossible for it to be lost under fair usage.

The motion was seconded.

F. W. Trapnell (Kansas City, Mo.) Suppose this tank is shifted and the outlet boot is broken off and missing, we would have to card the cap but would have no place to put it on because the owner would be responsible for the outlet boot.

M. W. Halbert: That is only a technical point; we all know there are a great many of these outlet caps left dangling to the chain. They are not put in the proper place and they become lost.

Secretary Elliott: The case Mr. Trapnell mentioned is exceptional. From the experience we have had with tank cars, I think when the outlet cap is gone it is through carelessness, not through maintenance. They are so important that they should be maintained. That note will be a reminder to the car inspectors to particularly notice those things.

F. W. Trapnell: At large interchange points we find it to be a fact that with that outlet cap on, they fail to close their outlet valve. The minute the least thing goes wrong you have lost your tank of oil. The car goes to the man at the refinery or to the owner of the tank. He unloads it, leaves his outlet cap down, and if it hangs low enough to strike the rails, it is lost when the switching crew comes in to switch that car out, perhaps on the right of way of the refinery that owns the tank. Then the car is handled maybe fifty or sixty miles and delivered to somebody else. You want to penalize the railroads for the owner's carelessness. The roads do not have inspectors at all of those points by any means. I do not believe that they should be made the delivering line's responsibility.

Mr. Koeneke (Indiahoma Refining Company): It is absolutely obligatory to load the car with the cap off. The valve must be tight or the car cannot be loaded. Furthermore, if a car is shipped to an industry on a railroad and a cap is left off after unloading, it is the railroad inspector's duty to see that the cap is applied. It is against the regulations of the Bureau of Explosives to leave the cap off.

F. W. Trapnell: I was chairman of a committee that visited about seven refineries in our territory with a delegation of foremen appointed by the Superintendent's Association and no one knew of our mission. In one case we asked a foreman to take off several caps. Two of them were leaking a stream bigger than your two fingers. Those caps were never off when he started to load.

A. S. Sternberg (Belt Ry. of Chicago): We have had two cases lately with ice frozen in above the caps. When the cars were loaded the valve was screwed down and they thought it was closed because it was solid against this chunk of ice. It was one-fourth open. That indicates that the cap was not taken off. The thawing out or something else broke the cap and we lost the entire tank of oil.

M. E. Fitzgerald: This argument is to the effect that the caps are on the cars. Mr. Halbert merely wants to penalize you when they are not on the cars.

The motion was lost.

Mr. Owen (Peoria, Ill.): On Rule 32, paragraph (N), I move that failure to close hopper doors or drop bottom doors on coal cars be made the delivering line's responsibility and cardable in interchange. This is to insure that the doors are properly closed so the cars are suitable for loading. Many doors are coming down after they have been partly put up and the change in the rule is for the safety of the train men in handling.

The motion was seconded and on vote was lost.

Chairman Gainey: Referring to the part of Rule 32 that reads:

Damage to any car (including cars on ferries or floats) if caused by:
(a) Derailment.
(b) Cornering.
(c) Sideswiping.

If you are shoving a cut of cars down through the yard and a flat car breaks in two, the trucks run together and probably one or two pairs of the wheels go off the track. It is argued that was not caused by a derailment, that it was caused by the car breaking in two. I think that part of your rule ought to be changed and made more clear.

M. E. Fitzgerald: Isn't it a fact that we have interpretations to the effect that you may break a car in two? If you break it or the air hose bursts and the wheels do not leave the rails, such a condition would be owner's responsibility. If the car left the rails, even though you could prove that it was due to the air hose bursting, it would be a delivering line's responsibility because the car was derailed.

Chairman Gainey: Your rule says, "If caused by," and the cause was not the derailment of the car. It broke in two before it was derailed and the car breaking in two—which is owner's responsibility in fair usage—caused it to be derailed.

F. W. Trapnell: The Arbitration Committee gave us a ruling on that. There was a car up in the Cascade Mountains on the Great Northern. It was broken in two, fell off to one side and pulled the truck off with it. They ruled that the car was derailed and that it was the delivering line's responsibility.

C. M. Hitch: This is not the same case. The car was derailed and rolled off down the bank. Chairman Gainey refers to a car that remains above the rails on the trucks with some of the wheels on the ties. In some cases they claim that is the handling line's responsibility and in other cases they say it is the owner's responsibility. Let us have an interpretation.

Chairman Gainey: I think that the Arbitration Committee's ruling is right, but the rule should be worded differently. Why not change it to read:

Damage to any car (including cars on ferries or floats) if:
(a) Derailed.
(b) Cornered.
(c) Sideswiped.

A motion to recommend this change was made and seconded.

Mr. Owen: If you have a collision or impact that would cause damage to that car sufficiently to cause it to leave the rails, paragraph (D) would cover that, would it not? I understand that the transportation department considers approximately six miles an hour as a speed of safety in switching. If they are going twenty-five miles an hour, it seems to me it is unfair usage and rough handling. If there is an impact or collision sufficient to damage the equipment and knock it off the track, it would be a handling line's responsibility.

Chairman Gainey: That is not the point I am trying to get at. If I am shoving a cut of cars, ordinarily switching, and that cut of cars breaks in two and two trucks run together and the body fell over, it would be an owner's defect unless one pair of wheels dropped from the rail; then it is a handling line's defect, regardless of how it happened. That is why I say the wording is not right.

M. E. Fitzgerald: The motion will cover that particular case, but you have eliminated all of the other provisions of the rule. You have not followed it up with a provision covering the other paragraphs of Rule 32. The rule would then read that you are only responsible to the owner for a car derailed, cornered or sideswiped, not responsible for material stolen, etc., as incorporated in the rule.

F. C. Schultz (Chief Interchange Inspector, Chicago): I think this whole rule is wrong. The old system of combination is properly regulated. What is the difference whether one wheel or both got off?

M. E. Fitzgerald: I quite agree with Mr. Schultz that the rule is all wrong. We were arguing on a certain motion, however, and I think, taken in connection with Rule 43, you practically have the combination. There is no provision in Rule 32 protecting the owner or connecting line receiving a car so damaged, the car coming under Rule 43. I think this should be referred to a committee and settled here.

F. W. Trapnell: That is the way to handle it,—put in the combination.

Chairman Gainey: We can pass this over until tomorrow.

The motion was withdrawn.

M. E. Fitzgerald: Paragraph (E) reads:

Handling of cars with broken or missing couplers or couplers out of place.

Follow that by saying:

Except in cases provided for in Rule 33.

Make it owner's defect if you break a lift-bar on a man's car. It now can be billed against the owner under Rule 33 if you break his grabirons due to raking and do not bring about other damage. Under Rule 32, paragraph (E), it says that if you damage any part of the car due to coupling on to it another car, then it is a delivering line defect. They conflict. What are you going to do?

J. J. O'Brien (T. R. R. A. of St. Louis): As I interpret this rule, it was to obviate the general practice of the yard men in congregating bad order cars on a specified track with couplers out. The penalization was put there in order to make you handle your bad order cars carefully.

M. E. Fitzgerald: I quite agree with Mr. O'Brien, and we mark our bill "No bill," if you please, but still the rules conflict; one rule says it is the owner's defects and when it gets to the billing office they say that we are wrong in marking it "No bill." One of those rules should be corrected.

H. W. L. Porth: I believe the simplest way to clarify that is to change Rule 33.

M. E. Fitzgerald: In Rule 33, if you damage a car by cornering or sideswiping, you repair the defects and do not have a right to bill the owner because you have brought about other damage in connection with your safety appliance. I have produced a case where I did not bring any other damage about. I merely broke the two grabirons and a lift-bar.

H. W. L. Porth: In the damage to the side ladder, that would be in connection with the sideswiping, or other defects on the car that would denote sideswiping.

Secretary Elliott: I do not agree with you. We have lots of cases where there is no other damage to the car; ladders that extend out and are fastened on with half inch bolts in the casting, are torn off and do not touch the rest of the car.

H. W. L. Porth: I think that Rule 33 should be changed. We have a lot of cases where cars are sideswiped and there is no damage absolutely to the siding. Where grabirons and ladders are damaged we have no redress.

A. S. Sternberg: Paragraph (E) is all right in the sense cited by Mr. O'Brien but it is unfair where you break a coupler in the yard under fair usage and do not have some way to get at the repair track without being penalized. I would like to see that changed something like this: "Handling of cars with broken or missing couplers or couplers out of place unless handled immediately to repair trucks."

Secretary Elliott: There is no way to check that.

Rule 33

E. H. Mattingley: It seems to me that Rule 33 should be revised to read this way:

Owners will be responsible for the expense of repairs to safety appliances, while not involved with other delivering line defects, including items mentioned in Rule 32, except damage to running boards on tank cars when sideswiped or cornered.

A motion to recommend this change was made and seconded.

M. E. Fitzgerald: I move an amendment changing it to read:

Owners will be responsible for expense of repairs to safety appliances where not involved with other delivering line damages except as provided for in Rule 32, paragraph (e), and damage to running boards on tank cars when sideswiped or cornered.

Mr. Pellien: Why not ask some one acquainted with the billing end of the rules whether or not in cases cited by Mr.

Fitzgerald, billing could be taken care of without change in Rule 32 or Rule 33?

Mr. Martin (B. & O.): I would say as far as we are concerned, if the card comes in to us marked "No bill" we let it go and do not bill them. We have no right to change marks on a repair card.

A. Herbster: Suppose a card comes to your office marked "One side ladder broken, raked," and there is no notation on it? What would you do with that?

Mr. Martin: I would mark it "No bill."

Chairman Gainey: Every car foreman in this room, if a ladder is raked off, is charging the owner of the car for it if there are no other defects. Mr. Fitzgerald is talking about the end of the car where you couple another car on to it with a chain coupler, and damage your safety appliances. He wants the rule changed to say who is responsible in that case.

Secretary Elliott: Mr. Fitzgerald has a car with a coupler pulled out. That is owner's responsibility. In handling that to the repair truck he bends two grabirons. Rule 33 refers to safety appliances where not associated with other delivering line responsibility. He has no other delivering line responsibility.

C. M. Hitch: He has the handling line responsibility when he attempts to handle a car with a missing coupler, rams into another car and damages it. That makes him responsible.

A. Herbster: Prior to the insertion of "Except damage to running boards on tank cars when sideswiped or cornered," it was admitted that the damage to tank car in cornering was owner's defect. Tank car people recognized that fact and had this clause inserted to make it a handling line's defect so they would be reimbursed. They realized that if you sideswipe a car and tear off a grabiron, that was a minor defect and the owner should stand for it. We do not want to call it a handling line defect.

Mr. Martin: The question was asked what I would do if the car was marked "sideswiped." Go back a few years when we bent grabirons and when we did not have Rule 33. Some of you remember that it was almost an endless job to have those cases settled. I think it was the intent of Rule 33 to make safety appliances an owner's defect. But there is a conflict with Rule 32 and there is no question about it.

Mr. Fitzgerald: Take a car similar to the case I cited. I am going to mark my repair card, "Caused by coupling on to car number so and so, account draw-bar pulled out." I am going to send it to the billing office marked "No bill" and the billing department is going to check on me, which all good billing departments do. They are going to say, "Why did you mark that card 'No bill'?" I will say "Rule 32, paragraph (e)." But they will refer me to Rule 33. I had no other damage on that car. They have a technical right to take that exception, as it is clearly in the rules. I want that clarified.

Mr. Owen: If you were to include paragraph (e) as suggested, you would also have to include paragraph (g), "Shifting of loads from other cars."

The motion, as amended, was carried.

Rule 43

M. E. Fitzgerald: Referring to Rule 43, I move that the foot-note be changed to read as follows:

In the case of damage to more than five longitudinal sills on wooden underframe cars, more than four longitudinal sills on composite wooden and steel underframe cars, more than three steel longitudinal sills on steel or steel underframe cars and both steel center members on tank *or other* cars constructed with two steel longitudinal sills only, the company on whose line such damage occurred must furnish owner statement showing the circumstances under which the damage occurred, if it is claimed that the damage was the result of ordinary handling. This statement in the case of cars reported under Rule 120 to accompany request for disposition of car, and in cases where it is not necessary to report car under Rule 120 to accompany the bill for repairs, *and to be furnished on request to receiving lines when cars are offered home in interchange where no Rule 120 request has been previously made.*

No company, tank car or otherwise, should receive any more consideration under the rules than any other car owner. Another reason is that cars are moving in interchange badly damaged, reaching the provisions of this rule, without any protection, and there is no provision in the rule to take care of a car so offered.

The motion was seconded and carried.

Rules 56 and 57

M. E. Fitzgerald: Referring to Rules 56 and 57, I make a motion that these both be eliminated.

The motion was seconded and carried.

Rule 58

M. E. Fitzgerald: With reference to Rule 58, I move that after the words "pressure-retaining valves" the words, "release valves and dust collectors where car is so stenciled," be included, for the reason that the rule is not clear and if a brake cylinder and reservoir is missing and offered in interchange, certainly the release valve is. We should protect all of the defects that could be associated with the other items mentioned in this rule.

The motion was seconded and carried.

Rule 60

F. H. Hanson (N. Y. C.): Referring to Rule 60, I move that a paragraph be added to Rule 60 placing an age limit for the removing of air hose for the reason that a great many roads already have an age limit. They remove the hose, say, when they become three years old. Other roads, possibly private line cars, allow their hose to remain on cars, and these are now being changed by roads that have an age limit. When you make out the bill you have to camouflage it and call it something else.

The motion was seconded and carried.

Rule 68

M. E. Fitzgerald: In connection with Rule 68, I move that it be changed to eliminate reference to delivering line's responsibility in connection with slid-flat wheels. I have no objection to advising inspectors what the limit is, but I want to make slid-flat wheels an owner's responsibility. The wording should be somewhat changed in order to do that, but I am not prepared to say how. There should be some instructions as to what a slid-flat wheel is.

The motion was seconded.

Secretary Elliott: Will you include in your motion that we eliminate reference in Rule 43 to Rule 68 also?

M. E. Fitzgerald: That is taken care of automatically.

The motion was carried.

Rule 70

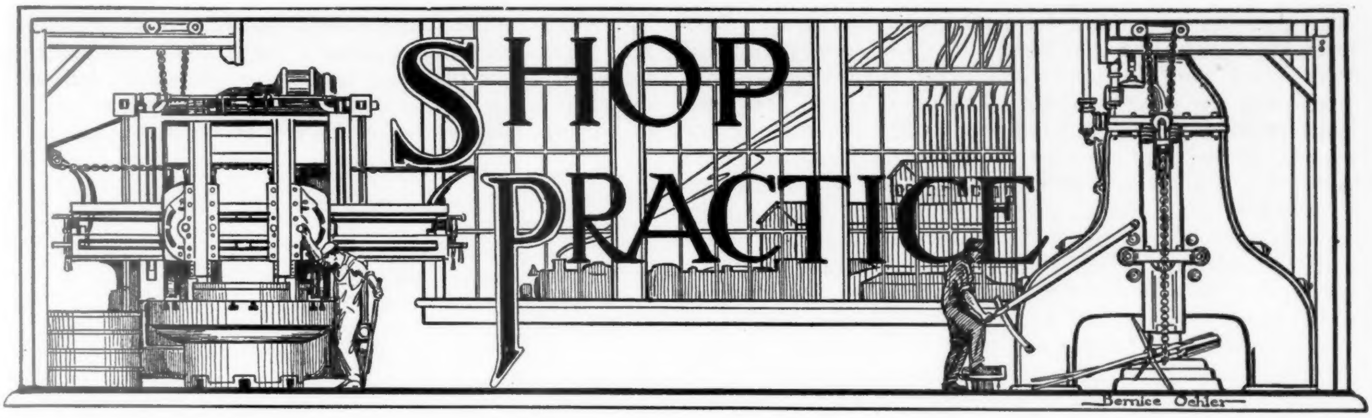
M. E. Fitzgerald: Referring to Rule 70, we have discussed the fact that defect carding for a cast wheel in place of a steel wheel is a joke. I move to eliminate Rule 70 so far as making the delivering line responsible. The owner is fully protected at the time the repair card is rendered. If you take out a pair of steel wheels and put in cast wheels, you owe the owner of the car some credit on the wheel. He has the right to get joint evidence and secure the same protection that he gets on other wrong repairs. He is not entitled to any other protection.

The motion was seconded.

F. C. Schultz: I used to feel that I could locate the man that put in the wrong wheels, but I cannot. They make changes without knowing they put them in. Inasmuch as the owner is protected, I think that this is entirely consistent.

A. Herbster: I think all of this change of wheels from rolled steel to cast iron took place during the railroad administration when no defect cards were applied. All of a sudden on a certain day the game was off and everybody commenced to slap on defect cards. That is the reason you could not locate the fellow that made the wrong repairs.

The motion was carried.



Uniform Heat Treatment of Steel*

BY H. C. LOUDENBECK
Engineer of Material, Union Switch & Signal Co., Swissvale, Pa.

To obtain uniform results in the heat treatment of steel is one of the most difficult of the heat treater's problems. Satisfactory results are dependent upon certain precautions which are often overlooked by the manufacturer. As a typical example, steel is purchased according to a specification that gives the desired physical properties when properly heat treated. The order is accepted by the steel mill and the steel manufactured and rolled accordingly. It is inspected by the purchaser's inspector who advises that it corresponds to the specification both chemically and physically and the shipment of the steel is then authorized. After it is received by the purchaser and perhaps retested, and he is satisfied that the proper heat has been shipped, it is unloaded in the stock yard either in a pile by itself or unloaded on a pile supposed to be of the same specification.

It is afterward discovered that through some error in marking the steel, it has been mixed with a heat having a different composition. The whole lot, however, has been delivered to the forge shop and made into forgings which were delivered to the heat treating plant, the results of which are obvious: irregularity, rejections, and endless trouble by the user. This is only one of the many irregularities which may be found after the steel has been received by the purchaser. For example, the steel may not be properly labeled or tagged or the tags may become lost and uncertainty exists as to the particular quality of steel stored in the yard. Again, parts of bars from the forge shop are returned to the yard, stored with steel of different composition, afterward made into forgings, the supposition being that the lot of forgings are identical in composition. From personal experience, the author is satisfied that great care should be used along these lines, especially as to the proper marking and storing of steel received in the forging yard.

If possible, each heat should be piled separately in the yard and correctly labeled with the heat number and specification number. When this particular lot is used for the forgings intended, this heat number should follow on the forging itself. If this requirement is too great for practical forging operations, heats of similar physical and chemical properties may be segregated and given a suitable code number representing the quality of steel. For example, a steel requiring 0.40 to 0.50 per cent carbon may be divided into two grades, namely, 0.40 to 0.45 per cent carbon and 0.46 to 0.50 per cent carbon. This will enable the forger to make less changes in marking dies and will also require fewer changes in heat treating.

Another element which enters into the irregularity of heat treated forgings is the variation in the same heat of steel. For example, carbon and sulphur often vary considerably due to a segregated condition. Practically every heat varies more or less in this respect. Of course, this variation may be caused occasionally by mixed blooms of the mill but usually, it is due to segregation in the ingot which will cause a variation in the composition of the bars rolled from it. In other words, the blooms from the upper portion of the ingot will contain a higher percentage of carbon and sulphur than blooms from the lower portion of the ingot. It will be readily seen that bars rolled from these blooms will vary in proportion. A few examples on the variation of carbon in the same heat are illustrated as follows:

Size of ingot inches	Ingot No.	Heat No.	Carbon in per cent bottom of ingot	Carbon in per cent top of ingot
20 in. by 20 in.	4	4323	0.46	0.48
....	17	....	0.47	0.52
....	4	6933	0.49	0.50
....	12	....	0.46	0.50
....	5	4325	0.53	0.63
....	14	....	0.53	0.63
....	3	6934	0.45	0.53
....	1	....	0.45	0.51
....	5	4333	0.54	0.61
....	15	....	0.55	0.66
....	3	4335	0.47	0.50
....	10	....	0.44	0.51
....	4	7437	0.44	0.48
....	12	....	0.45	0.52

These are not exceptional heats. They were taken from the usual run of open-hearth practice. The ingots were cropped at the blooming mill until free of pipe as indicated by the shearing. This required from 20 to 35 per cent shear-

What Is the Prime Requisite of a Foreman?

Must a foreman be a master craftsman in order to make good?

His job as a foreman is to inspire others and direct their efforts. He must be an executive, and, more than this, he must be a good business man, although this latter requisite is only just becoming evident in the railway operating world.

These requisites do not call for expert skill as a mechanic; they demand something very different and far more difficult.

What course should be followed in order to develop and select this kind of material for supervisory positions?

*Abstract of a paper presented by title at the Philadelphia convention of the American Society for Steel Treating.

ing. Samples were taken from the upper and lower bloom after the discard had been taken. It can be seen readily that bars rolled from the upper and lower blooms would have practically the same composition as given above. The sulphur in these particular heats was quite low, running not over 0.035 per cent, usually in the neighborhood of 0.025 per cent and no great segregation was shown in this respect. It would be interesting to observe the effect of high sulphur, say 0.06 per cent in the ladle analysis in regard to segregation since many contend that sulphur running 0.06 per cent or slightly over does not have a detrimental effect on the physical properties of the steel. While this may be true, it should be considered that most specifications specify that the drilling should be taken half way between the center and outside of the bar. When this is done it does not represent the sulphur which may be segregated in the center.

Our experience has been that segregation is more liable to take place when the sulphur runs over 0.05 per cent than otherwise. It has been found that where the sampling is done according to the accepted method, a variation from 0.06 per cent, half way between the center and outside, to 0.12 per cent, when taken from the center of the bar, this steel will not make a desirable forging and will cause considerable irregularity during the heat treating process.

Irregularity in physical properties of forging often is caused by variation in size and thickness of the forging at different portions, and in some cases this is very difficult to control in order to have a uniform hardness throughout the piece. For example, an axle having a pad considerably thinner than the main body of the axle will refine and harden much stronger than the main portion. While this is overcome, to a certain extent, in the drawing operation, the final results will show considerable variation in the parts. It is difficult to overcome this and it often is necessary to draw the axle so that it will show a minimum hardness in the body in order to bring the hardness on the pad to the maximum. In other words, a study must be made of the piece to be hardened before a definite program of hardening is accepted.

By abnormal heats is meant heats of steel having the proper chemical composition, but not having normal physical properties under regular heat treating. One particular heat which contained 0.36 per cent carbon and used for axle steel was difficult to refine with the ordinary process except in very small sections. Ordinarily no difficulty was found in hardening this steel to 250 Brinell by quenching in cold water from a temperature of 1,550 deg. F. However, in this particular case the maximum hardness obtained was 185 Brinell. The analysis showed it to be normal with the exception that it contained more than traces of aluminum. The steel manufacturer may draw his own conclusion as to the finding of aluminum in steel but we cannot but think it had something to do with the difficulty in refining the steel.

In our experience, cold water should be used for quenching wherever possible as it has better penetration and gives more uniform results.

The hardness of low carbon steels, however, can be considerably raised by quenching in a caustic soda solution. The strength of this solution should be 1 to 4. We have raised the hardness of a 0.20 per cent carbon steel from 185 to 300 Brinell by means of this quenching medium. This was obtained on a section about 3 in. by 4 in. It is necessary when using a solution of this sort to use a circulating system to keep the quenching medium cool.

Where oil is used it has been found that a grade of paraffine oil having a viscosity of 190 at 80 deg. F. gives good results. This is improved by the addition of a small amount of fatty oil. The addition of 20 per cent refined whale oil gives excellent results.

This article is intended to afford suggestions of a practical nature rather than a dissertation on the fine points of the art. Of course, it is understood that it is necessary to have the proper heat treating furnace, the proper temperature control, the proper time and manner of quenching, but unless the right grade of steel is provided for the purpose and steel of uniform quality, the results will be far from uniform.

Machining Driving Boxes

Various machines have been especially equipped for the rapid machining of locomotive driving boxes and generally some type of boring and turning machine has been used. In the case illustrated, an ingenious adaptation has been made of a machine intended for another purpose. A Sellers car wheel boring machine has been equipped with a two-jaw universal driving box chuck and proves very effective for the operation of boring the crown brass and facing the hub liner.

Sellers Car Wheel Borer Equipped for Machining Driving Boxes

The boring ram has been fitted with a head carrying a single boring tool and the facing operation is performed by the side facing head. The particular advantages of the machine are the ease and rapidity of centering the box by means of the universal chuck and the fact that no re-chucking is necessary for facing the hub liner. In addition, this arrangement eliminates danger of the hub liner being out of square with the bore of the box.

Cast Iron Cutting

The possibilities in cutting cast iron with oxy-acetylene have been demonstrated at a large Indiana manufacturing plant where, in remodeling some of the powdered coal furnaces in the power plant, it was found that the cast iron floor plates for the upper deck were several inches over size and would have to be cut off. The plates had been hoisted and bolted into position at one end before it was discovered that

the other ends extended over instead of resting on the center of the supporting I-beam. The attempt to correct the fault by cutting off the excess lengths with drilling tools proved very slow work and, after two and one-half days of continuous drilling, during which time gangs of brick masons and machinists were forced to wait in idleness, only two of the four plates had been cut. The two remaining plates were cut in one hour and 45 minutes by oxy-acetylene operators, using standard Oxweld type C-6 torches, the work being done accurately so that the finished plates were found to line almost perfectly with the center of the beam. The plates were 1¼ in. thick and 60 in. long, the operation consuming 310 cu. ft. of oxygen and approximately 100 cu. ft. of acetylene. An interesting feature was the fact that the cutting was effected directly over and without injury to the beam.

Fuel Economy by Accurate Valve Setting

BY J. McALLISTER
General Foreman, West Albany Shops, New York Central

The possibilities of saving fuel by properly adjusting valves on locomotives equipped with outside valve gears are not fully understood. There are three methods of squaring valves on engines equipped with these gears: first, by equalizing valve travel; second, by equalizing lead, and third, by setting valves to correct, equal piston cut-offs. The first method is the cheapest and quickest as it does not require putting the engines on rolls. It is a simple matter to make

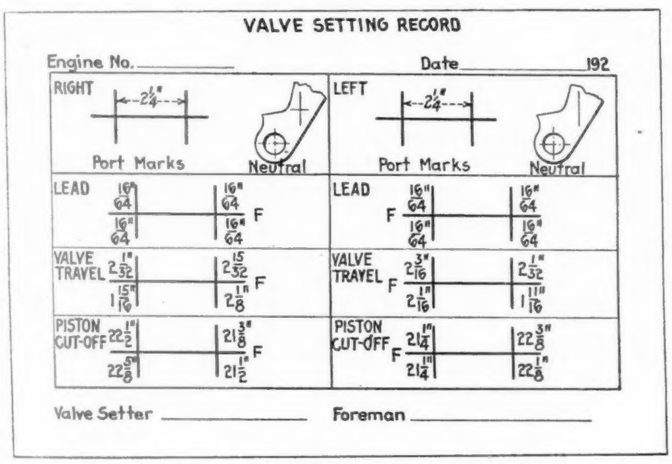


Fig. 1—Valve Events In Full Gear

a gage that will set the crank arm to an approximately correct position. Then all that is necessary is to scribe port marks on the valve stem, trail the engine and mark the valve travel, making what alterations are necessary to equalize the travel. In the second method it is necessary to place the engine on rolls in order to check the leads which are usually squared in the full gear.

The third method, although seldom used, is the only correct method of squaring valves. It is no more necessary that the ports open exactly the same distance than that they stay open the same length of time. In other words, the ports should stay open until the piston has traveled the same distance front and back, right and left.

In the third method the engine is placed on rolls with the main rods up and the lead squared in full gear as in second method, but the work is carried further: that is, the reverse lever is placed in the cut-off position (about 25 per cent), the engine run over and the piston travel measured at cut-off. Necessary alterations in the motion work will then make the piston travel the same at the points of cut-off.

It seems to be the prevailing opinion that if the valve travel or lead is equalized the other valve events will occur in regular order. Such, however, is not the case. On some locomotives, no matter how carefully the motion work is repaired and assembled, valve events do not follow in regular order.

The valve setting records shown illustrate this point clearly. These are not theoretical records, but copies of some filled out by the valve setter for an engine actually in service. Fig. 1 shows the lead, port opening and piston cut-off in full gear after alterations were made to square the lead. The lead was ¼ in. all around and attention is called to the fact that the piston travel at cut-off is one inch too great at the back end on both sides of the engine. The port openings are not at all in the same proportion.

Fig. 2 shows the events of the stroke with the reverse lever

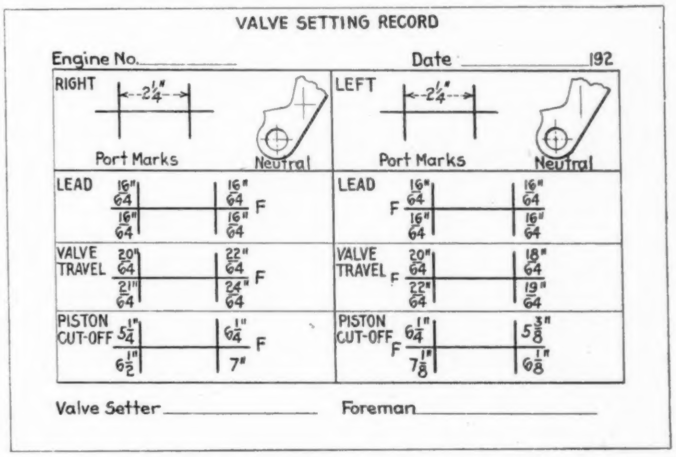


Fig. 2—Valve Events With Reverse Lever "Hooked Up"

hooked up in the running cut-off position, no alterations being made. The piston travel is still about one inch too long on one side but has changed from back to front. The port openings are more equally divided.

The valve events after alterations were made to equalize the piston cut-off at 6 in. all around are shown in Fig. 3. Note the distortion of the lead, also that the port openings have crossed over, leaving the larger opening in back. This

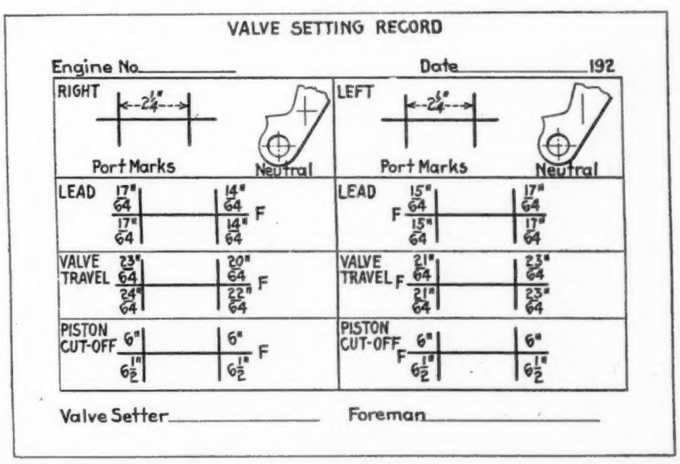


Fig. 3—Valve Events With Alterations to Equalize Cut-Offs

makes it evident that lead, port opening and piston cut-off do not follow in regular order.

Unequal piston cut-offs have a serious effect on fuel economy. Assuming an engine is capable of making running time with a tonnage train at 6 in. cut-off, with valves squared as in Fig. 3, if the engine is held in shop and the leads are squared as shown in Fig. 2, the engineman cannot now make running time with the same train. The cut-offs will be at

$5\frac{1}{4}$ in. and $6\frac{1}{4}$ in., and the reverse lever will have to be dropped. Assuming that the engine has either a screw reverse or a very fine tooth quadrant so it is possible to get a 6 in. and 7 in. cut-off, more steam than necessary will be admitted to each cylinder on each revolution. In other words, coal used to make that steam will be wasted and the total amount so lost in each trip will be considerable. The total amount wasted on all divisions will represent a serious economic loss to the country.

It is felt that the conditions found on this locomotive are by no means exceptional and resultant savings are large enough to warrant the most careful attention to squaring and equalizing the cut-offs in valve setting.

Some Facts Regarding Bearings

BY LOUIS A. SHEPARD

President, Hart Roller Bearing Company, Orange, N. J.

The use of ball and roller bearings which are correctly designed and accurately made in transmissions, machine tools and all machinery, subject to heavy, continuous operation is essential to reduce friction. Instances are known where the power saving over plain bearings in large factories so equipped has amounted to as much as 50 per cent, but this is exceptional. Ordinarily 15 to 25 per cent is more nearly correct. Undoubtedly there is a saving, which in medium sized factories even, is very appreciable in the course of a year and is a great help in reducing the overhead expense.

Not only is there a saving in power, but by using bearings particularly adapted to the machines, almost continuous operation is insured and the annoyance of shut downs to reline, adjust or replace plain bearings is avoided. This alone more than compensates for any increase in the first cost of application of the anti-friction bearings, for the loss of time and product is far in excess of any ball or roller bearing costs.

It is a well known fact that workmen usually do not give the proper attention to the cleaning and lubrication of plain bearings. In consequence great friction develops, the bearings burn and wear out quickly and generally require renewal at just the time when the shop is busy and machinery should operate continuously. In many cases repairs are made over the week end, but this is expensive and pay for overtime counts up rapidly. A properly designed ball or roller bearing, packed with the correct lubricant properly enclosed will operate at least fifty times longer than a plain bronze or babbitted bearing under the same conditions. This also makes a big saving in the amount of lubricating oil which must be used.

Often too little attention is given to the mounting and enclosing of the bearings, which can be so enclosed as to maintain the lubricant for long periods of time and prevent oil leaking or dripping on the floor or on material which is being manufactured. The load carrying capacity and speed of operation of ball and roller bearings exceeds that of the plain, bronze or babbitted bearings. Also ball or roller bearings having no adjustments are fool proof and will outlast other parts of the machine. In certain cases of adjustment being provided in machines the mechanism has been practically ruined by workmen tampering with such adjustments. As an additional advantage economies in space can be achieved by replacing the plain, bronze or babbitted bearings with ball or roller bearings.

In a sense the ball and roller bearing each has its particular field, yet a correctly designed roller bearing is generally superior to a ball bearing for load carrying purposes. Because of inherent features of design, a ball bearing is usually best suited to carry relatively light loads at high speeds of rotation. A roller bearing, on the other hand, is superior to the ball bearing for carrying large loads at moderate speeds and is admirably suited for installations where shock loads are encountered. A ball bearing cannot successfully absorb shock loads unless its rated capacity is far in excess of that which a roller bearing must have to carry successfully the loads occurring in the actual operation of the machine.

Given a ball of certain diameter and a roller of the same diameter with its length equal to the diameter, the roller will, for a given load, have a greater surface contact with its raceway than the ball. The direct compressive stress over this area of contact will therefore be smaller for the roller than the ball. Assuming a maximum safe working stress, the roller will safely carry a greater load than the ball at all speeds of rotation, since the drop in capacity at different speeds, due to fatigue stresses, is approximately the same for each. Size for size, made of the same material, and operating at the same speed, the roller bearing will, for a stated safe working stress, generally carry approximately 50 per cent greater load than the ball bearing. On the basis of dollars per pound capacity it is evident, therefore, that a roller bearing is a more economical installation than a ball bearing.

As the ball makes contact with its raceway under load, a certain area at the top of the ball and a certain area at the bottom of the ball, differing slightly in magnitude, will be in direct compression. The form of this surface contact area will be a warped ellipse. As a result, instead of having point contact at the top and bottom of the ball, surface contact occurs and a series of points on each side of the highest point of the ball will be touching the raceway. Since the ball should theoretically rotate about its own axis, and since the speed of rotation of a point on the periphery of the ball varies as the distance from an axis through the center of the ball, it follows that for any load applied to the bearing there will be a certain amount of slippage. This slipping tendency will further increase with an increase in load since the surface contact increases with increased load. The result is a sliding effect on the raceway which slowly but surely grinds it away. Slippage is not met with in correctly designed roller bearings. All points on the periphery of the roll necessarily have the same velocity at any stated speed of rotation of the bearing. Ball bearings are therefore limited in load carrying capacity by practical reasons in addition to the theoretical considerations already advanced.

A great many ball bearings are designed to carry both radial and thrust loads simultaneously, by employing angular contact between balls and races. Since it is a practical impossibility so to design the bearing that the velocity of each point of contact will be the same an additional spinning action is introduced.

This tendency, together with the slippage resulting inherently from any contact between balls and races, causes two different and distinct spinning effects on the raceway. For any appreciable radial and thrust load the wear and tear on the raceways is of serious import. A bearing should be designed for the performance of one function only. As one manufacturer of high grade ball bearings states in his catalogue, "radial and thrust loads cannot be carried ideally in one bearing simultaneously. Where combined radial and thrust loads must be carried, combination bearings (one radial and one thrust) assure maximum efficiency and durability."

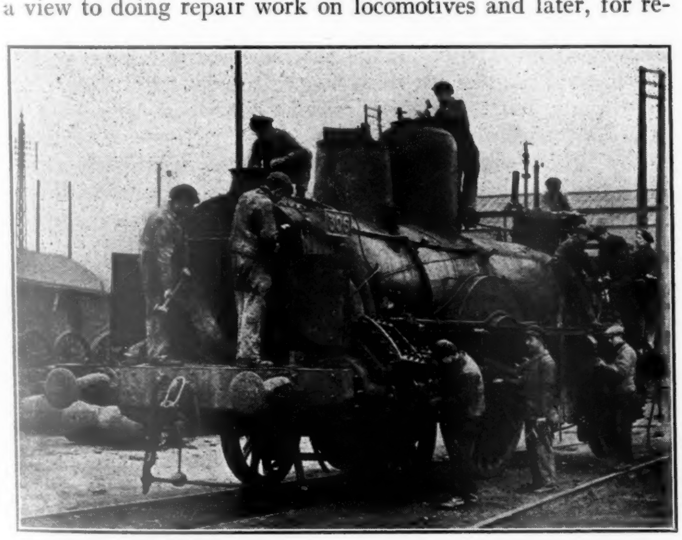
In any ball or roller bearing it is desired to obtain true rolling motion, revolution of balls or rollers around their axes in parallel planes, which means freedom from slippage and skewing and elimination of wear on parts. Load carrying capacity and speed also have to be considered. A properly designed and accurately manufactured roller bearing fulfils these requirements and becomes a money saving investment.

Paris-Orleans Apprentice Class Studying Mechanics

Paris-Orleans Apprentice Work Organized*

A Description of the Development of Courses for Apprentices of the Paris-Orleans During the War

THE Paris-Orleans during the war developed apprenticeship in its large repair shops and engine houses in 27 localities (37 apprentice schools). Schools at two large repair shops in Tours and Perigueux train apprentices for the various special work of repairing locomotives, cars, and trucks. Apprentices are trained at roundhouses with a view to doing repair work on locomotives and later, for re-



Locomotive Being Stripped by Second Year French Apprentices Before Being Taken Into Shop

cruiting as enginemen. In some exceptional cases they are also trained as boilermakers, machinists and blacksmiths at roundhouses. The total number of apprentices at these various points at the present time is about 1,200. The apprentices are given professional instruction of the widest possible range, and as wide a theoretical instruction as their intelligence and length of apprenticeship permits.

The practical training is based on the following principle: "Apprentices should be watched and trained as carefully in their work as in their studies." Work which has no practical utility is reduced to a strict minimum and as soon as their professional knowledge allows the apprentices undertake practical work. The result of this method is to interest the apprentice who, knowing that he is doing useful work, puts more energy into it. He is paid from the start, being employed on useful work, and this helps lighten the burdens of his family.

The theoretical training consists of French classes, arithmetic, geometry, physics, mechanics, drawing and technology classes which occupy the apprentice about six hours a week.

Terms of Admission

The age of admission is between 14 and 17 years, according as the candidates are or are not holders of a certificate for primary studies. However, in the case of young men with a higher education (pupils of secondary schools) the age limit of 17 years may be raised. Apprentices answering to the above conditions and who have made a request for admittance, signed by their parents, either to the chief offices of the company or to the staff department in Paris are called to undergo a medical examination and a short entrance examination composed of: Dictation of 20 lines, with some grammatical difficulties; problems on the four rules and on one question of surface and volume; division of whole numbers, with proof by multiplication; reading.

After this examination, the candidates who have passed the medical examination are classed in order of merit and admitted according to the number of places vacant. Preference is given to sons or relatives of employees, to children of large families and to apprentices who already have some knowledge, that is, who have taken the pre-apprenticeship classes or supplementary classes.

Every boy binds himself to finish his apprenticeship in the establishment and the trade where he began and to remain in the company until his military service. An apprenticeship contract to this effect is signed jointly by the boy

*Translated and abstracted from an articles by M. Lacoin, chief assistant engineer, and M. Chassagne, mechanical engineer of the Paris-Orleans, in the August, 1920, issue of the Revue Generale des Chemins de Fer.

and his parents or guardians. The penalties for breaking this contract are: non-payment of the cash prizes mentioned below, which are normally paid at the end of the apprenticeship; proceedings against the parents or guardians for damages or injuries caused to the company by the apprentice leaving.

The number of apprentices in each establishment is regulated so that the total number of apprentices and workmen who are minors, does not exceed 25 per cent of the adult staff of workmen in any shop. Each apprentice remains on an average five years in the establishment before his military service. The number of apprentices admitted each year is therefore, on the average, five per cent of the strength of the adult staff of workmen in the establishment.

Instruction of Apprentices

The instruction given to apprentices consists of a professional manual education complemented by theoretical explanations, arithmetic, drawing and spelling, which last for about six hours per week. Wherever possible, apprentices are grouped in the workshop under the supervision of an instructor who is thus enabled to direct the instruction of 10 to 15 apprentices.

The employment of a single instructor has the advantage of allotting to this post the best qualified workman and gives to the new apprentices a single plan of work, which depend upon the instructor's qualifications. It also permits of more individual instruction, the apprentices being taught orderly habits of work and good conduct.

As far as possible, an instructor is chosen who is able to direct practical and theoretical instruction of the apprentices at the same time, thus maintaining a constant connection between the two branches. This object has been attained in some shops, but it is difficult to find teachers who unite practical and theoretical knowledge and in some large centers special teachers have been employed for the theoretical classes, keeping in as close touch as possible with the practical instructors.

Apprentices in Enginehouses

The program of practical instruction in the engine houses is slightly different from that in the repair shops because the former are only called upon to train engine fitters who can later become engine drivers and directors of repairs to locomotives.

The apprentice school program of the enginehouses is as follows: *First year.*—Half the day, the morning by preference, is devoted to methodical and progressive practice in fitting and to theoretical classes (18 hours fitting, and six hours of theoretical classes per week). The rest of the day is taken up by practical work in the repair of detail parts. The program of progressive exercises to be carried out by the apprentices is given in a book of machining notes and includes a course of work of about 10 months on the average. To complete the first year of practical instruction, apprentices who have performed their progressive exercises well are given supplementary exercises chosen from the following work: making or repairing face plates, V-ways, shifting-gages, various keys, screw and case dies, hammers, graving-tools, chisels, spanners, etc. Drilling machines, pneumatic hammers, parts of machine-tools in the workshop, etc., are overhauled and repaired.

Second year.—In the second year the apprentices cease to be systematically employed on the vise. The "mounting" apprentices are, wherever the number makes it possible, grouped in special gangs aided by one or two chosen workmen and a small number of laborers.

Thus organized, they carry out in its entirety the half-yearly and yearly repairs to simple locomotives or in some cases to compound locomotives, including the fittings, cocks and valves. This arrangement makes them learn all the work of mounting while preventing them from being employed as minor laborers, as is too often the case when apprentices are placed in a gang of workmen.

In localities where this arrangement cannot be carried out the "mounting" apprentices are either united with the third year apprentices or with the minor workmen to form a special gang under the conditions mentioned above, or grouped under the direction of an instructor to make part of a repair gang. They are not placed alone in the gangs even with a good workman. By isolating them in this way there is too much risk of making lesser hands of them, whose professional training would be mediocre.

The instructors see that they do not do work which is beyond their strength, and make each apprentice take the different places in the gang so that they do not specialize.

First Year Apprentices in Fitting Shop of Paris-Orleans

Third year.—In the third year the apprentices are still supervised and like those of the second year are grouped in special gangs under the direction of a chief mounter or chief of a group and carry out the half-yearly and annual repairs to locomotives, modern ones by preference, taking the place of the ordinary gangs entrusted with these repairs. In establishments where their number is small, they are united under the supervision of the chief of a group of men who have just finished their apprenticeship, thus forming a special gang. The best third year apprentices are made use of as monitors in the second year gangs.

In the course of the third year the apprentices also take in rotation a course of one month each in the forge, boiler and machine shops respectively. These courses, the program of which is drawn up in the beginning of the year, are described in a special notebook so that their proper execution can be checked by the inspectors. After completing the course, apprentices in roundhouses have a knowledge of locomotives which is a great aid in helping them to qualify as firemen and later enginemen.

Apprentice Work in Repair Shops

The program of practical instruction in the repair shops is as follows: apprentices (except those in wood-working, painting, upholstering and molding, who are few in numbers, and who begin immediately in their respective workshops) are placed in a school for iron-workers situated in the fitting shop. In this school they follow a program similar to that for apprentices in the enginehouse, and their time is divided between study and practical work. After six months they take a professional examination, the result of which is taken into account in deciding their definite distribution among the classes of mounters, fitters, machinists, boiler-makers and blacksmiths. In this distribution the physical aptitudes

and tastes of the apprentices are also taken into account. The classification once made, the fitter and mounting apprentices remain in the iron-workers' school where they follow an identical program to that of the apprentices in the enginehouse. The boiler-maker apprentices and the blacksmith apprentices are placed in two special schools where they follow practical courses extending over a year.

The instruction given in the boiler-makers' school includes: a knowledge of descriptive geometry necessary for tracing the intersection of solid materials; tracing of sheet-irons in general; finally, the manual work of a boiler-maker.

The instruction given in the blacksmiths' school includes the theoretical rules for blacksmith modelers, the rules of soldering and the general work of a blacksmith.

After a year in the special school, that is to say about 18 months in the company, the boiler-maker and blacksmith apprentices are considered to have finished the special courses necessary to a knowledge of their trade and are placed in the boiler-makers' and blacksmiths' workshops where they do only practical work under the direction and with the advice of experienced workmen.

Theoretical Instruction

The theoretical instruction of shop apprentices covers three years. In the second year the apprentices revise the work already studied in the first year, and in the third year they take a special course of technology. Experience has shown that this procedure gives good results and has moreover the advantages of facilitating the organization of the classes.

Theoretical classes are held every year from October 1 to July 31. They last for six hours a week during the two first years at the rate of four sittings of about one and one-half hours, and only one and one-half hours per week in the third year.

The total number of instructors is 47 and the classes they teach are in addition to their normal work. They are distributed as follows: master mechanics, three; foremen, six; checkers, sub-inspectors, two; assistant foremen, ten; heads of gangs, nine; workmen, two; employees, 15, six being ladies.

First Year Apprentices in Forge Shop

Instruction is by means of specially written elementary courses drawn up by a central department and distributed to the instructors and to the apprentices. Abstract methods of explanation are avoided by referring to the various operations and apparatus used in the workshops and conducting demonstrations with the apparatus itself. The explanation of the lesson is aided by frequent questions to the pupils, followed by a short résumé.

The first and second year courses, which are the same, include 170 lessons in general technology, drawing and sketching, French, arithmetic, elementary physics and mechanics. The third year apprentices have at their disposal a course of study in technology including 40 lessons, one per week affording an elementary knowledge of the locomotive. This instruction is given in the form of appendices, the details of which are given below:

Appendix 1.	Boiler	6 lessons	30 lessons
Appendix 2.	Wheels, frames, suspension	4 lessons	
Appendix 3.	Parts, motors, arrangement of mechanism	15 lessons	
Appendix 4.	Various parts, special devices, tender, boiler, work and reading of graphs and diagrams	5 lessons	

These lessons are given by means of sketches, demonstrating apparatus and the parts of the machines themselves, either in the lecture room or in the workshop.

In the course of the three years the apprentices take oral and written examinations at the end of every half-year, in order to show the progress made. These also serve as a basis for proposals for increase of wages and bonuses, which are mentioned further on.

The apprentices' instruction is also at all times checked by means of questions put by foreman and higher agents of the central department on their rounds in the instruction centers. This checking of the apprentices' knowledge is also a check of the teaching given by the local instructors. Instructors should realize that technical instruction is only one part of the professional training, and that it is equally important to instil into the apprentices habits of discipline, order, method, self-respect, in a word, give them a moral training.

Competitions and Remuneration

Competitions are arranged at the end of the first year's apprenticeship after the half-yearly examinations, among the best students in the various shops and roundhouses of the company. At the end of these competitions there is a distribution of prizes, books and instruments, to the prize-winners. At these distributions, apprentices who have satisfactorily finished their apprenticeship receive a savings-bank book in which are inscribed the amounts of the various half-yearly bonuses accorded during the course of their apprenticeship, and an "end of apprenticeship" diploma.

The apprentices commence work at 25 cents, 30 cents or 35 cents per day, according to their value and their age, with successive increases based on the results obtained during the course of the apprenticeship. The apprentices may, therefore, attain at the end of their three years' apprenticeship, a daily wage equal or superior to that of the best junior workmen in the shop. They also draw special allotments on account of cost of living and residence, and those who have had more than 18 months' apprenticeship receive a premium of 10 cents per working day.

In order to interest parents in the children's work, the apprentices' progress is shown every month in an individual notebook in which is recorded professional skill, theoretical instruction, conduct, money advances allotted, and money drawn. This notebook is signed by the officer in charge of the apprentices who writes in it any observations he thinks it useful for the parents to see. The latter also sign this notebook after having noted each month the remarks made therein. The parents are also directly communicated with when their son does not give satisfaction in his work or his conduct, and are advised of all punishments he undergoes.

Second Grade Apprentices

Those young men who, in the course of their first year of apprenticeship, show that they are capable of attaining a higher degree of efficiency than the average, are allowed to follow extra classes called "second grade," which last three years. These young men have a special contract with the

company signed by them or their parents or legal guardians. A résumé of the second grade classes is given below:

THEORETICAL SECOND GRADE CLASSES

First Year

1. Arithmetic.
   Algebra (functions of equation of the 2nd degree).
2. Geometry, plane and solid.
3. Mechanics (elements up to the determination of the centre of gravity).

Second Year

1. Mechanics (static and dynamic).
2. Physics.
   The Steam Engine.
3. Geometry, ordinary graphs.
   Descriptive Geometry (elements).
   French.

Third Year

1. Mechanics—rudiments of resistance of materials.
2. The Locomotive.
   Internal Combustion Motors.
3. Descriptive Geometry, drawing.
4. Electricity.
   Chemistry (rudiments).
5. Rudiments of political economy.
   French.

The second grade courses are carried on by means of correspondence. The pupils belonging to the different shops of the company receive the necessary directions for their studies from the chief agent and four assistants in charge of this course of instruction, who reside in Orleans. A summary of the lessons to be learned and instructions as to the works and pages to be consulted is sent to apprentices on Friday of each week. They have to make a résumé of the lessons learned in this way in a special exercise book, and this book is sent every two months to Orleans to be examined.

Second grade apprentices only study in common with their companions of the first grade, the technology and drawing classes. But so as to facilitate the study of the second grade program, three periods of study per week of 1½ hours each are given. These take place preferably during the time of the French classes, calculation, geometry and first grade physics, which they do not attend. It is necessary for them to complete these studies by private study outside of working hours.

An examination is held every six months, on the subject matter studied during the previous half-year. It includes written tests followed by oral tests. These oral examinations take place before a special commission which visits the principal centers where the pupils are grouped. They test by the questions put how the pupils are assimilating the knowledge which is being given to them by correspondence, and take advantage of this meeting to complete the knowledge required, explain and clear up the points which are obscure. At the end of the year, the best pupils receive prizes like the first grade apprentices. There are 32, 22 and 30 second grade apprentices in the first, second and third years respectively.

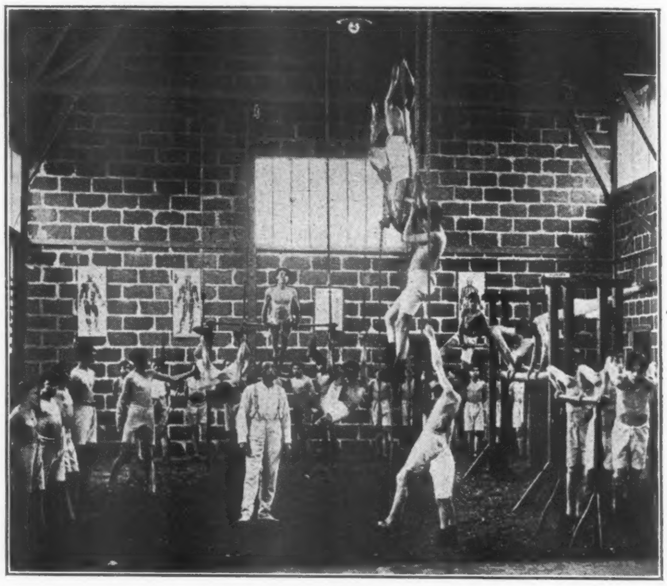
Physical Culture

With the object of improving the physical development of the young men, the company encourages an interest in sport among its staff, and especially among the apprentices. The heads of local departments take an interest in the work of physical development and to this moral aid is added pecuniary aid consisting in annual subscriptions to the sports associations formed by the employees of the company. At present there are nine associations of this kind. The company has, moreover, furnished a room in the repair shops at Tours and Perigueux, and organized classes for physical development for apprentices of less than 18.

Results Obtained

One of the greatest obstacles which is encountered in apprenticeship is the instability of the apprentices. They leave their employers as soon as the apprenticeship comes to an end, and even during the course of the apprenticeship. As a matter of fact, the wastage, which was fairly large before the reorganization of apprenticeship on the Paris-Orleans, has considerably diminished. The way in which apprenticeship is made to lead directly to the railway trade, and the various bonuses which are only paid at the end of the period of apprenticeship have a good effect. At the last promotion the wastage at the end of the third year did not exceed one per cent.

The apprentices who have followed the complete course after reorganization are sufficiently numerous to allow of estimating exactly the value of trained workmen. They have shown themselves clearly superior to the average of the



Gymnasium for Apprentices on the Paris-Orleans

workmen who were engaged before the war after military service. The output of the gangs of second and third year apprentices is excellent. As the total number of apprentices was 1,200, it may be hoped that the former apprentices will in future form the nucleus of the whole working staff, and that a very appreciable rise in professional and technical value will result.

The second grade apprenticeship has shown each year about 30 young men who are of clearly superior capacity to the average and anxious to improve their knowledge. The second grade work, which is done outside the hours of manual labor, requires much energy and tenacity on the part of the apprentices. It may therefore be hoped that the old second grade apprentices will have the energy, and assure the basis of recruiting for head workmen, foremen, chief mechanics, and a part of the chief assistants in the shops, and that the result will be a still greater improvement of the average professional value among this class of employees.

It would be interesting to estimate the economic output of the organization apprentice which is, however, difficult to do with exactness on account of the complexity of the problem. The wages paid annually to the apprentices are about 3,500,000 francs. The general cost of the instruction is about 100,000 francs. The machinery which the apprentices repair is at a standstill a little longer than that which is repaired by regular gangs of workmen and this concludes the debit side of the apprenticeship account.

The credit side is more difficult to establish. The work done by the apprentices is in the first year very decidedly below the cost of the apprenticeship. In the last year the situation is reversed. On the whole, it seems that the value of the work produced corresponds very well to the cost of apprenticeship. We may therefore consider that the improvement of facilities for recruiting and developing valuable employees will be a clear profit.

Four Efficient Santa Fe Machine Shop Devices

Too Much Attention Can Hardly Be Given to Jigs and Fixtures Which Really Save Time or Labor

BY J. ROBERT PHELPS
Apprentice Instructor, Atchison, Topeka & Santa Fe, San Bernardino, Cal.

IT is often possible by the use of comparatively simple jigs or shop devices to extend either the range or kind of work performed on machine tools, the following devices having been developed and tried out with good success at the San Bernardino shops of the Atchison, Topeka & Santa Fe.

Turning Bevels on a Boring Mill

A device, used on a boring mill when cutting bevels or slants, as found on piston valve spiders, followers or bull rings, is illustrated in Fig. 1. A lathe may not always be

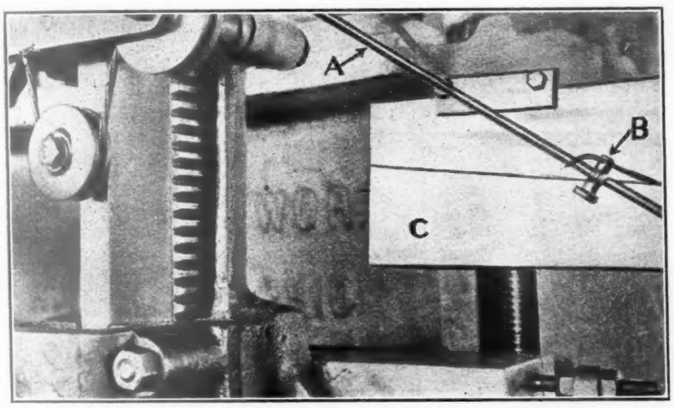


Fig. 1—Bevel Indicator Applied to Boring Mill

available for this work and in a certain case a large number of spiders and followers had to be turned on a boring mill. As the mill feed forced the tool out, it was necessary for the machine operator to maintain the down feed by hand, just enough to give the piece being machined the desired taper. In order to tell when the down feed was correct, the device illustrated was developed.

A 5/16 in. round steel rod *A* is electric welded to a rod key base plate approximately 5 in. by 2 in. by ⅝ in. To add stiffness, a shorter electric welded rod extends from the base plate to the initial rod at a point about 12 in. from the base. The base plate is fastened to the top of the boring mill tool bar by means of two ⅜ in. cap screws through suitable holes in the base plate, a standard surface gage scriber *B* being slipped on over the 5/16 in. rod. A piece of sheet iron *C*, chalked or white washed is secured to the frame of the boring mill as shown, and a line drawn on it at the required slant or angle which it is desired to cut. With this arrangement it is comparatively easy for the machine operator to feed the tool down by hand just fast enough to keep the point of the scriber on the line. The principle can also be readily applied in machining to an irregular line.

Removing Lathe Chucks

The method of swinging a lathe chuck out of the way to make room for a small job between the centers is illustrated in Fig. 2. On this particular lathe, it is often necessary to take off the chuck several times a day. With the arrangement shown a right angle arm *A*, arranged to swivel, is secured by means of brackets to the back of the lathe. Rod *B* with an adjusting nut on the top and a threaded lower end passes through a hole in arm *A*. The chuck is drilled and tapped to receive one end of rod *B* which has been previously threaded.

In operation, the chuck is loosened on the lathe spindle and the bolt *B* is turned into the chuck, the adjusting nut at the top being tightened until all slack is taken up. The lathe is then run back either by hand or power and the chuck comes off and can be readily swung back out of the way. After the job between centers has been done, the chuck can be swung forward and easily re-applied. This arrangement makes it possible for one man to handle a heavy chuck easily and in addition the chuck is kept off of the floor where it would be in the way and accumulate dirt.

Combination Square Attachment

An attachment to be used on a combination square in setting up driving boxes for boring is illustrated in Fig. 3. It is essential that the boxes be bored parallel with the shoe

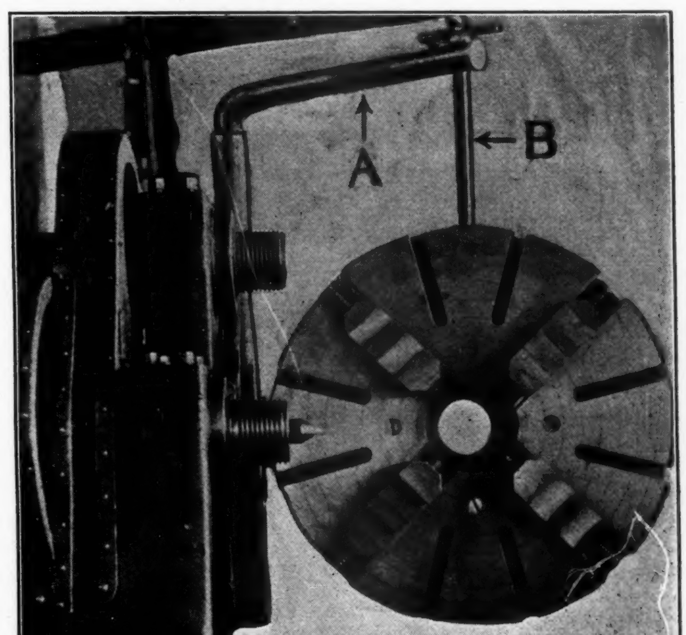


Fig. 2—Swinging Arm Facilitates Removal of Chuck from Lathe Spindle

and wedge faces and at right angles to the hub faces. This device affords a convenient and effective means of checking the driving box set up.

As shown in the illustration, the device is simple and consists of a piece of sheet metal drilled with five holes to reduce weight and attached to a sliding head which may be held in any position on the scale by means of a thumb screw. The plate reaches over the driving box flange and makes it

unnecessary for the operator to caliper from the scale over to the shoe and wedge way. He can tell at a glance whether the box is set up so that the bore will be parallel with the shoe and wedge. Approximately 180 boxes a month are being machined at this point and while this device saves only about three minutes on each box, the total saving in time is

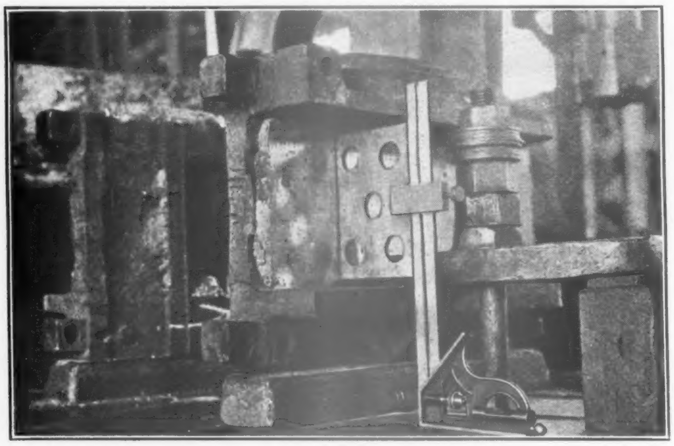


Fig. 3—Combination Square Attachment Aids in Setting Up Driving Boxes

important. In addition the device makes possible more accurate work.

Extension Table for Milling Machine

In cases where it is desired to perform a small milling machine operation on the end of a shaft or long machine part the extension table and V-blocks, illustrated in Fig. 4, can be used to good advantage, saving a considerable amount of time in setting up and assuring an accurate job. As shown, a slot is planed in this extension table or plate square with a rib on the under side so that in applying the plate all that

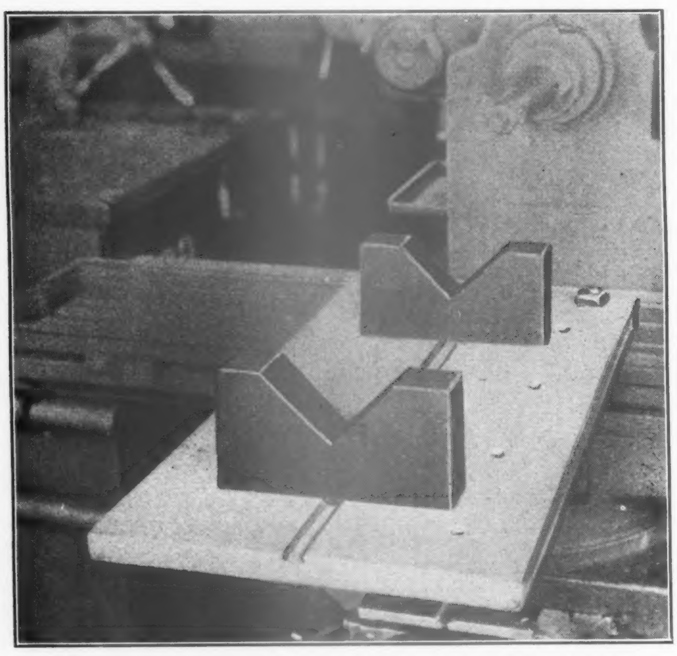


Fig. 4—Extension Table and V-Blocks for Milling Machine

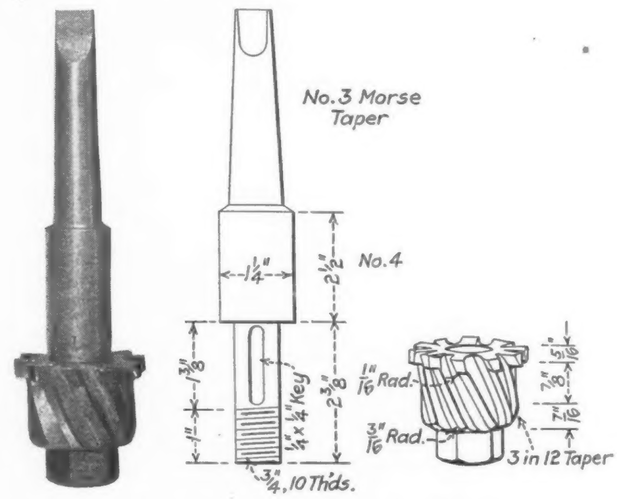
is necessary is to tighten up two ⅝ in. by 2½ in. bolts to have the table square. Two V-blocks are arranged to slide back and forth in the groove as shown so that they will be square with the table in any position. This device opens up the machine to a much wider range of work, as for example the boring and facing of rocker arms on the boss ends and other similar machine operations.

Reaming Tube Sheet Holes

BY GEORGE BREXTON
Tool Foreman, Grand Trunk Shops, Stratford, Ont.

For the rapid and smooth reaming of tube sheet holes, the tool illustrated has been found very satisfactory. Reamers formerly used for this work consisted of a roughing reamer of the shell type and a straight flute, finishing reamer for finishing. The roughing reamer had a taper of ⅜ in. in 12 in., but was found to be useless in the hands of a careless operator owing to the fact that there was no gage to indicate the size of the hole which, in many cases, was made larger than necessary. In addition, the long, spiral flutes caused a great deal of difficulty from sticking. The objection to the straight flute finishing reamer was the leaving of chatter marks and the necessity of changing from a square to a No. 3 Morse taper socket.

The new reamer, illustrated, is designed to perform both operations of roughing and finishing. It is made of Mushet



Reamer for Roughing Out and Finishing Tube Sheet Holes

high speed steel having a radius of ⅜ in. on the bottom cutting edge enabling it to remove rapidly any ragged edges or marks left by the ripping tool. A taper of 3 in. in 12 in. is provided on this reamer for a distance of 7/16 in. as indicated. This tapered section rounds out the tube hole and the ⅞ in. parallel cutting edges finish it to the correct size.

A round filleted shoulder at the top removes the sharp edges on the tube sheet and prevents the copper ferrules from being cut in the process of beading or expanding. The reamer is detachable from its spindle as shown in the illustration, being held from revolving by a ¼-in. key. The spindle is machined to a No. 3 Morse taper. On account of the removable feature, the reamers can be changed easily from one size to another with the aid of a short ¾-in. spanner or wrench to tighten the holding nut.

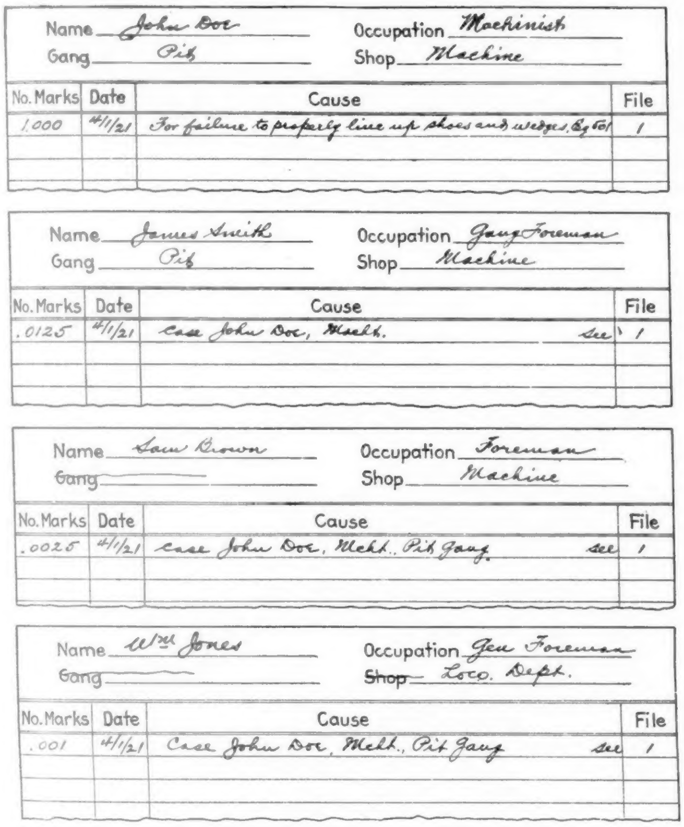
PROTECTING METALS AT HIGH TEMPERATURES.—Calorizing as a means of protecting metals exposed to high temperatures is discussed in an article by Arthur V. Farr, recently published in the *Iron Age*. The treatment fuses aluminum into the exposed portion of the metal so as to form a homogeneous aluminum alloy for a certain depth, ranging from a few thousandths of an inch to the permeation of the entire mass. The formation of the oxide, alumina, prevents the penetration of oxidizing gases. The aluminum oxide surface must be preserved unbroken, and for this reason, machining is best done before the calorizing process. Calorized parts have been successfully used for carburizing and annealing boxes, pyrometer protection tubes, stoker parts, conveying apparatus, for furnace linings and baffle plates.

A System of Progressive Shop Discipline

Foremen and Men Are Held Accountable for Mistakes In Proportion to Their Individual Responsibility

BY GRANT GIBSON

AN editorial published in a recent issue of the Railway Age contained the following statement: "The selection of men for prospective foremen should not be left to chance, as past experience has amply demonstrated the possibility of keeping personal efficiency records whereby the master mechanic or shop superintendent is enabled to tell at a glance which one of his employees will probably best fill a vacancy among the foremen."



Name John Doe — Occupation Machinist
Gang Pit — Shop Machine

No. Marks	Date	Cause	File
1.000	4/1/21	For failure to properly line up shoes and wedges, Eng 601	1

Name James Smith — Occupation Gang Foreman
Gang Pit — Shop Machine

No. Marks	Date	Cause	File
.0125	4/1/21	Case John Doe, Mach.	see 1

Name Sam Brown — Occupation Foreman
~~Gang~~ — Shop Machine

No. Marks	Date	Cause	File
.0025	4/1/21	Case John Doe, Mach. Pit Gang	see 1

Name Wm Jones — Occupation Gen Foreman
~~Gang~~ — ~~Shop~~ Loco. Dept.

No. Marks	Date	Cause	File
.001	4/1/21	Case John Doe, Mach. Pit Gang	see 1

Fig. 1—Card Form for Individual Records

The above statement is true and there is no reason why efficiency records should not be maintained in railroad mechanical departments, as well as in transportation departments where the Brown discipline system is generally adopted. The latter system shows the merits and demerits of employees in the transportation department and the superintendents have little difficulty in selecting the right men to fill vacancies in the ranks of the supervisors.

In railroad shops in the past personal feelings, or the foreman's recollection of a man's past performance often decided who should be promoted. More recently the question was settled by seniority rules and irrespective of ability. Both of these methods are decidedly inefficient and it is, imperative that, to promote men intelligently, personal records must be maintained. The system proposed in this article will also result in checking up the ability of gang foremen, shop foremen, and general foremen. It is just as essential to maintain an efficiency record for the man who is now supervising as it is for the workman who will eventually be a supervisor. We want to know how efficient the gang foreman is in supervising his men because he may be needed as a shop foreman. Similarly, the shop foreman should assume a just proportion of the errors made by his gang foremen and the men working under them.

In other words, the supervisory force should be assessed for all mistakes, careless or otherwise, that occur under their jurisdiction as after all they too are responsible. Give them a black mark for these errors and it won't be long until those who are responsible for repeated demerit marks will show improvement or be released.

Numerals can be used to designate demerits, one demerit mark for a casual incident, two for one of a semi-serious nature and three for a serious one. It is necessary to designate a maximum number of marks in a given length of time to cause dismissal. For example, any employee who might get fifteen demerits in one year would automatically dismiss himself from the service. On the other hand, a clear record over a given period should eradicate a certain number of marks. The following is an outline of fundamental suggestions, the finer points of which could be easily worked out to fit local conditions.

In order that the system be equitable, a gang foreman must not be assessed one full mark for each mark given one of his men as ere long a gang foreman with a number of men would soon reach 15 marks and be out of service. Neither should a gang foreman handling forty men be assessed as heavily as one handling twenty men as in the first instance the foreman has a greater number of men to watch and, therefore, is up against a greater hazard.

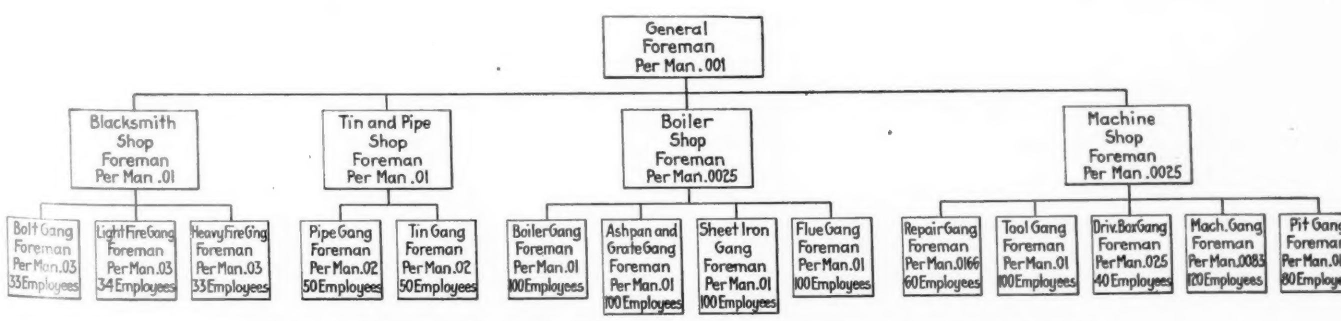


Chart 1—Percentage Demerits Charged Against Gang, Shop and General Foremen

The solution is to assess in percentages. The individual

who makes the mistake is given one mark and his gang foreman is given a percentage of one mark based on the number of men in the gang. Chart 1 is an example of this percentage system and is based on a locomotive department employing 1,000 men. Note that the gang in the right block (pit gang foreman) consists of 80 men. Divide 1.000 by 80 and the result is .0125. The machine shop foreman has jurisdiction over 400 men. Divide 1.000 by 400 and the result is .0025. The general foreman is responsible for 1,000 men and should be charged with 1.000 divided by 1,000, or .001. Therefore, should one mechanic in the pit gang make an error, that calls for record discipline, he would be assessed 1.000 mark; his gang foreman .0125; the machine shop foreman .0025, and the general foreman .001.

It will, of course, be necessary to institute a card form for this individual record and Fig. 1 illustrates such a form and the entering of an error which affects the individual record of the four men as previously explained. These cards should be filed alphabetically in the general foreman's office. A file would have to be inaugurated to fit this system, arranging it numerically and giving the first case File No. 1, etc. Notification in writing of the individuals concerned is only fair so that their attention may be called to any black marks on their records. At the end of each month, the several cases of demerits should be summarized and bulletins posted covering them, leaving out the name of the individual concerned.

The principal virtue in this idea of progressive discipline is in the fact that the man higher up cannot overlook careless employees as his record suffers by reason of the mistakes of subordinates. If there are two or three marks on a foreman's record caused by the carelessness of one man, he is certainly going to keep his eye on this man and put the machinery in motion to educate him or else show cause to dismiss him.

Second, a progressive discipline system as proposed would make it simple for a general foreman to make his recommendations to the master mechanic to fill a vacancy as a gang or shop foreman. If, for example, he needed a machine shop foreman an examination of the discipline cards of gang foremen would show the best man at a glance.

Another quotation from the Railway Age reads: "It is difficult to find an argument not already advanced for the more careful selection and training of railroad shop foremen." The proposed system of progressive shop discipline would do much to facilitate both the selection and training of shop foremen.

Soft Packing Cutter

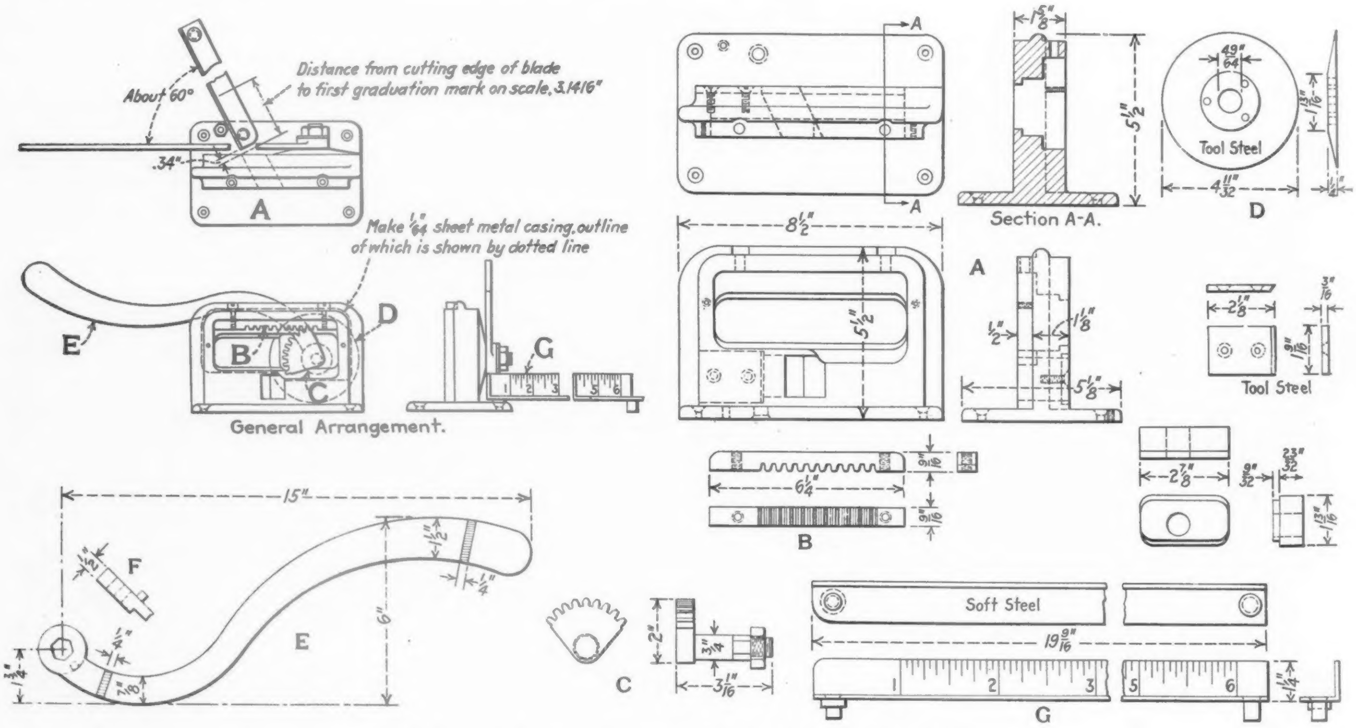
BY NORMAN MACLEOD

Much waste in cutting fibrous packing for globe, angle, blow-off valves and miscellaneous valve stems can be eliminated by the use of a cutter which has been designed and proved satisfactory in one of the large shops of a prominent railroad. Details and the general arrangement of the cutter are shown in the illustration. The cutter consists of a frame *A* bolted or screwed to a work bench. Attached to the frame is a rack *B* in which is engaged a quadrant gear and shaft *C*. A circular hardened steel cutter *D*, operated by handle *E*, is slipped on shaft *C* and moves with the quadrant. Stop *F* regulates the throw of the quadrant.

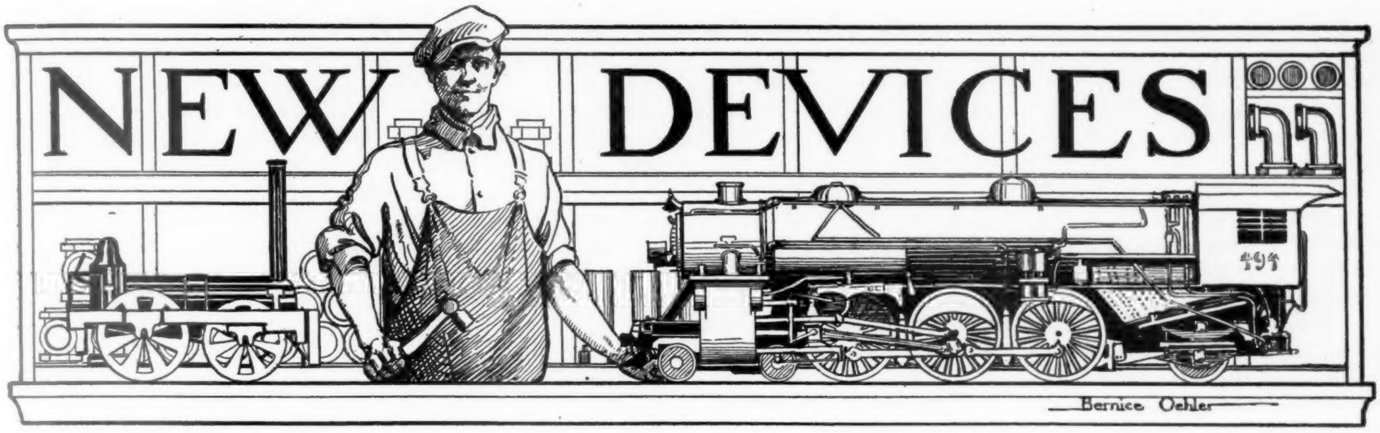
Attached to the frame proper is a graduated gage *G*, the scale of which is marked for the various diameters of rods, in this case the graduations varying up to 6 in. in diameter. This gage is preferably made of an angular section to allow the packing to be held firmly and squarely while it is being cut.

Operation of the device consists in placing the packing through the opening in frame *A* provided for the purpose and cutting off one end, which will be at about 60 deg. according to the angle of the gage. The packing is then pushed on through until its extreme end coincides with the figure or graduation on the gage which represents the diameter of the rod for which the piece is intended. An overthrow movement of the handle gives the steel cutter a circular and also, with the rack and quadrant gear, a horizontal movement which carries the cutter through the packing.

The gage being set at an angle of about 60 or 65 deg. the ends of the packing are cut at such a bevel that when it surrounds the rod a tight joint is made.



Details and General Arrangement of Soft Packing Cutter



Special Railroad Draw-Cut Shaper Attachments

THE special railroad draw-cut shaper, as finally developed by the Morton Manufacturing Company, Muskegon Heights, Michigan, is a heavy duty production tool capable of performing a large variety of machine operations in railroad shops. Owing to the fact that the cut is taken on the return stroke of the ram, deep cuts can be taken with coarse feeds and smooth, accurate work is assured.

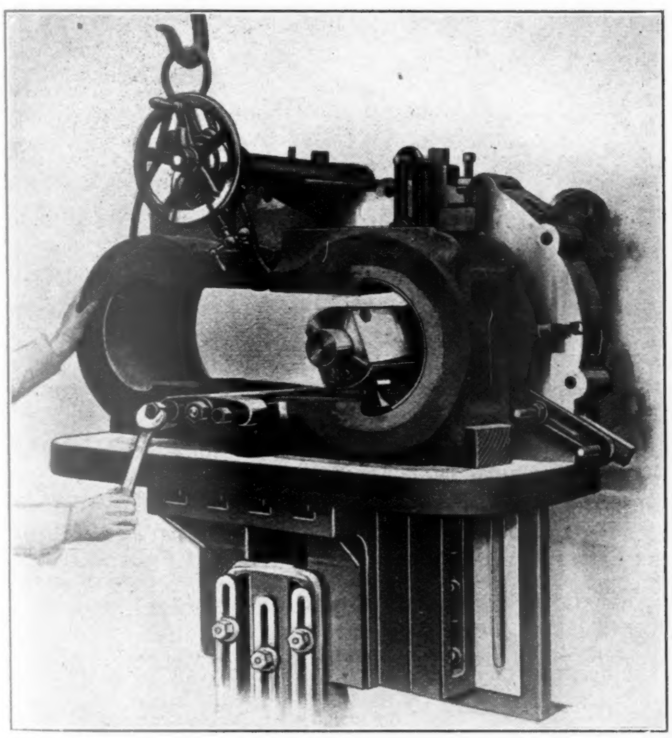


Fig. 1—Morton Double Chuck Driving Box Attachment

If the Morton draw-cut shaper was so highly specialized that it could be used only in machining driving boxes, its installation would be warranted only in those railroad shops having enough driving box work to keep the machine busy eight hours a day. The shaper can, however, be used on general machine work and special attachments have been designed for machining driving boxes all over and for finishing crown brasses, shoes and wedges, and main rod brasses. The addition of these attachments greatly increases the range of work for which the shaper is adapted and it can now be installed with profit in much smaller shops and roundhouses than heretofore. The flexibility of the machine and the ease of changing from one attachment to another make it a general utility tool which can be kept busy a large proportion of the time.

Double Driving Box Chuck

An improved double chuck for holding driving boxes is shown in Fig. 1. This chuck is made in the form of an angle plate which bolts securely to the knee of the machine and is alined at right angles to the ram. It is provided with a suitable opening for the ram and a special rotating head to pass through. Adjustable stops and binders secure the various sized driving boxes to the chuck.

A bracketed journal fastens to the top of the chuck and extends forward, bringing the operating hand wheel in a convenient position as shown. Power is transmitted through a universal shaft to the rotating arbor, which may be turned by hand in either direction. A limit stop screw is also provided in connection with the hand wheel so that the tool may be relieved on the return stroke when finishing the under-cut fit.

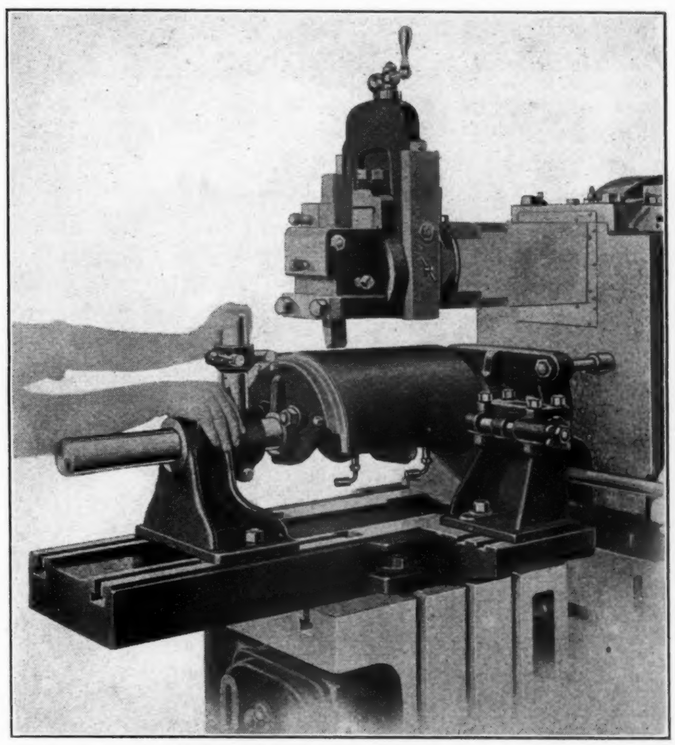


Fig. 2—Crown Brass Planing Attachment

In machining a driving box, the sides are first planed on the shaper without the use of the attachment. The attachment

is then applied and one driving box centered by means of a scriber fitted to the micrometer projection of the rotating head. Micrometer setting of the tools is provided and the crown bearing can be machined accurately to size. The second box may be set up while planing the crown fit of the first box.

The under-cut fit is first roughed out while roughing the crown, a special forming tool being used for finishing. This tool can be set at a standard angle and rotated by hand feed so as to machine the box exactly to the line. The tool is relieved at each stroke and the stop advanced until the finish line is reached. After the brass is pressed in it may be planed to fit the journal if desired and a very true surface obtained by using a slightly crowned tool. For planing the shoe and wedge fit an extension bracket is bolted to the side of the knee and face of the saddle.

Planing the Crown Brass

For planing the outside of driving box crown brasses a special attachment is provided as shown in Fig. 2, a practical and efficient device for performing this machine operation. The base of the attachment is a rigid casting held in line with the ram by a tongue on the lower side. The arbor shown is rotated by a worm gear and turns freely in the head stock and tail stock bearings. The chuck for holding the brasses is keyed to the arbor and is held firmly against a shoulder by means of a clamp bolt. Set screws for lining and centering may be operated from the under side, and both front and rear heads are provided with set screws for holding brasses

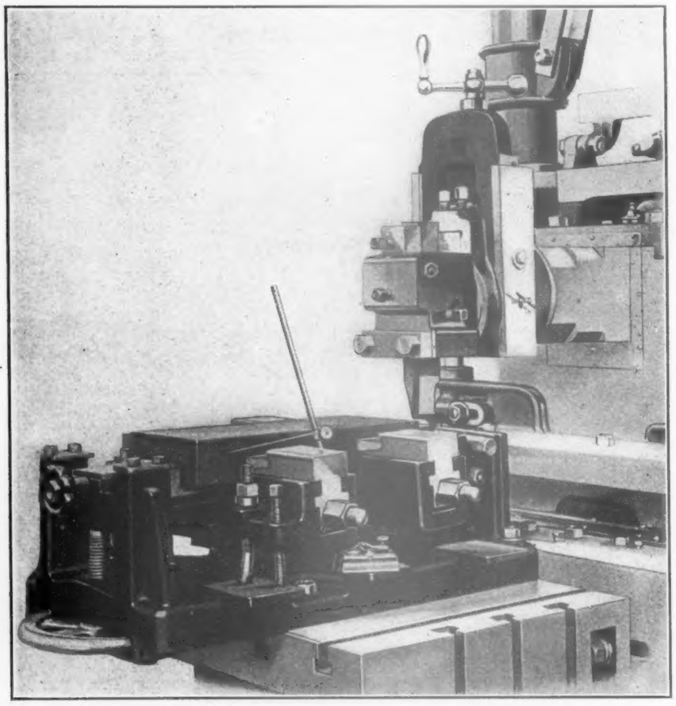


Fig. 3—Shoe and Wedge Planing Attachment

with rough ends. The two heads are drawn together by bolts so placed as to produce great pressure.

Chucks of different diameters are furnished for the various sized brasses and different lengths may be accommodated by means of the adjustable front head. The feed is obtained through a worm gear and shaft, connecting with the ordinary feed mechanism. Power feed in either direction is provided and the brass can be machined to the line scratched by the micrometer scriber. Adjustable transfer gages make it easy to caliper the driving box and determine the exact angle and position of the under cut. This angle is transferred to the crown brass by means of an outer gage.

Shoe and Wedge Attachment

An attachment for finishing the face bearings of shoes and wedges after they have been laid out and lined is illustrated in Fig. 3. Its construction is such as to make it readily adjustable to various angular requirements, all adjustments being made after the shoe or wedge is securely fastened in the attachment. One roughing and one finishing cut only is required. The principle of operation of the attachment will be evident from the illustration. The four adjustable jaws are expanded by a draw bar and a single screw. These jaws center the wedges of different size, bringing the inside (frame fit) parallel with the ram. Both sets of binders shown move

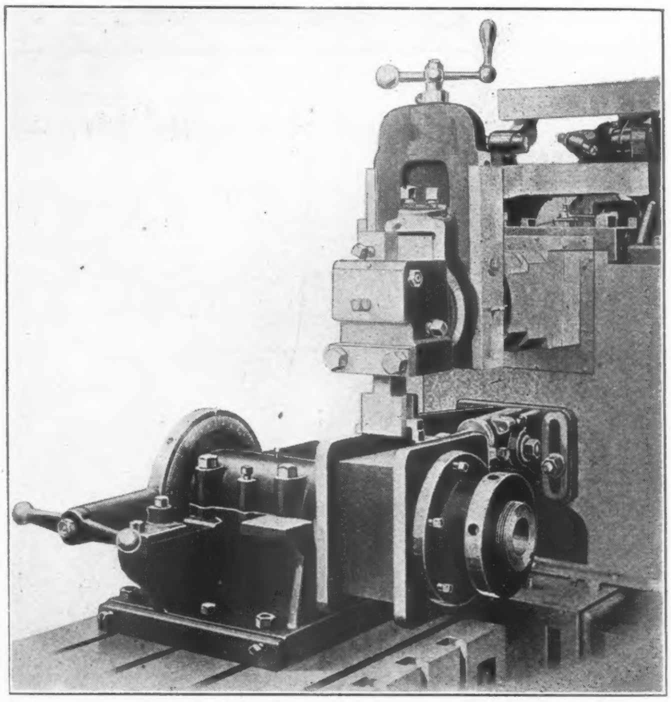


Fig. 4—Attachment for Machining Strap Fit in Rod Brasses

freely in T-slots and are operated by single screws. The screw for elevating is operated by a hand wheel while the roll is obtained by means of two studs shown. When planing shoes the studs are loosened and the bar is elevated until it comes against a stop provided to hold the bar parallel with the shaper ram.

Machining Rod Brass Fits

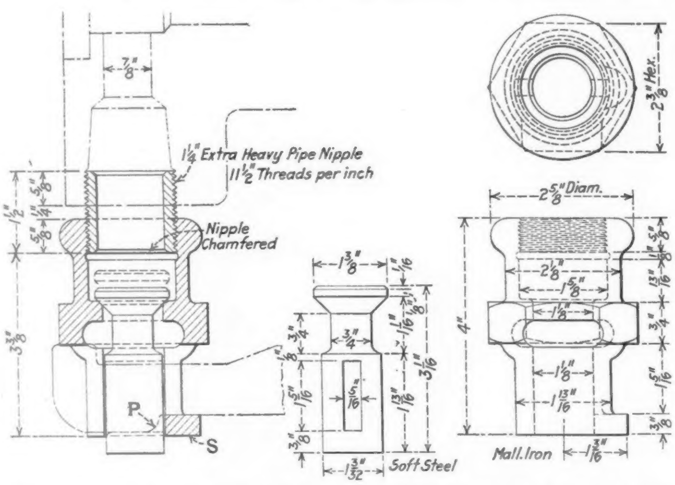
Connecting rod brass fits in the straps can be accurately and quickly machined by means of the attachment shown in Fig. 4. The base plate of this device is provided with a tongue cast on the under side and fitted to a slot in the knee. The head is arranged to swivel on the base and is provided with set screws to secure perfect alinement, clamp bolts securely fastening the arbor in any desired position. Chucking is accomplished by fixed and sliding collars, pressure being applied to the sliding collar by a lever operated nut. Both collars are provided with cup pointed set screws which hold the brasses firmly and make it unnecessary to sweat the two halves together. An index plate is keyed to the rear end of the arbor and is provided with a plunger locking it securely at 90 deg. points. One side is graduated to 360 degrees so that any desired angle may be obtained.

The special tool holder furnished with this attachment is made of heavy machined steel slotted along two sides and one end to receive angular cutters. Two cutters are used at one time so constructed that they can be fastened in the holder independently of each other. With this form of tool

holder, both sides of the strap fit may be machined at once to the exact size and parallel. An adjustable gage for setting the tool may be furnished consisting of a key-seated rod, one solid and one adjustable jaw. The gage is set by placing it directly on the strap and locking the adjustable jaw into position. The exact size is thus obtained for setting the tool.

Cylinder Cock Closes When Engine Drifts

A DEVICE for holding cylinder cock valves on their seats when an engine is drifting has been patented recently by L. P. Ligon, master mechanic, Norfolk & Western, Roanoke, Va., and found of great value in assisting lubrication and preventing dirt and other foreign matter from entering the cylinders with resultant unnecessary cutting and wearing. When cylinder cock bodies are of malleable iron and the valves of wrought iron, the seat cuts rapidly due to the valves being lifted by the vacuum in the cylinder when the engine is drifting. When brass or other soft metal is substituted for the wrought iron valve, the soft metal pounds out, necessitating frequent renewals.



View Showing Details and Cross Section of Closed Cylinder Cock

To prevent a cylinder cock valve from lifting when the engine is drifting a projection *P*, as shown in the illustration, has been made on the operating bar to engage the bottom of the slot in the valve when closed and hold it to seat. The projection enters for the full width of the valve when closed and passes out before the valve reaches the incline on the operating bar for opening it. A shelf *S* is made on the cylinder cock body to furnish additional support for the operating bar.

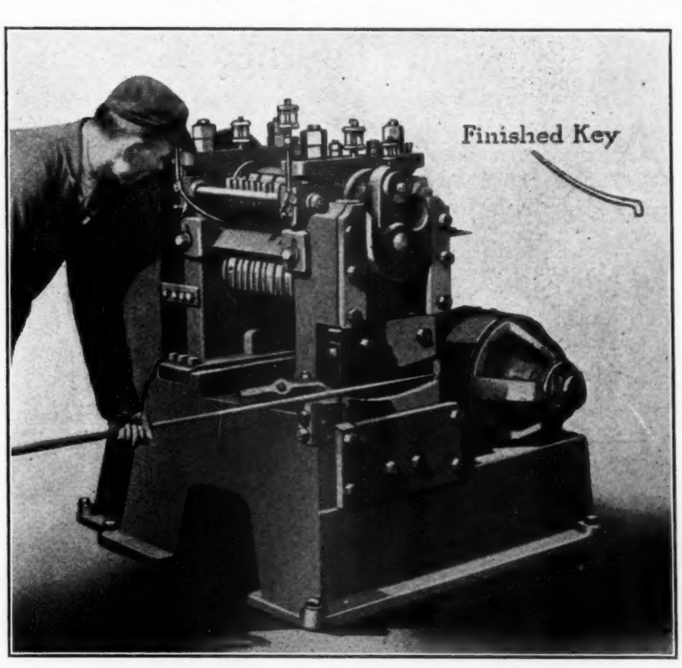
Engines equipped with cylinder cocks using this device have been in continuous service for more than a year without any renewals whatever being made, or any attention given to the cylinder cocks.

Brake Shoe Key Taper Rolling Machine

ALTHOUGH brake shoe keys have been produced by taper rolling for a number of years, many railroad men are not familiar with this process. Not only is the production of keys much greater but they are more uniform and of better quality than those obtained by drawing down under the hammer. The brake shoe key rolls, built by the Ajax Manufacturing Company, Cleveland, Ohio, have two horizontal roll-shafts to which are attached semi-cylindrical roll-dies, grooved to produce the taper of the key and operating between heavy housings. The upper roll-shaft is carried in slide housings and the pinions on the ends of the roll-shafts have exceptionally long teeth, so that the distance between roll-shaft centers can be varied. This adjustment regulates the thickness of the keys and also permits re-finishing the roll-dies, when they become worn, thus materially increasing their life. A side press operated from the upper roll-shaft shears off, bends and turns up the gib head on the brake shoe keys.

Either ½ in. by ⅞ in. rectangular or ¾ in. round stock of a convenient length to handle is used for making keys. Where cars are being wrecked, considerable scrap rod is available for this purpose. The stock is heated over a length of about two feet. The roll-shafts to which the dies are attached revolve continuously and during the half revolution when the roll-dies are not engaged, the operator ports the heated end between them against stock gages in the back. Front and rear guides hold the stock in position so that when the roll-dies engage, the stock enters into a groove and is rolled out toward the operator. He again ports it back into another groove making alternate flattening and edging passes.

Rectangular bars require only about four passes in the two flattening and one edging groove of the roll-dies; rounds require about six passes in the same three grooves, but the decrease in production because of the additional passes is more than compensated for when scrap rods are being thus reclaimed. The key is then sheared off the bar, bent and



Ajax Brake Shoe Key Machine Performing the Final Operation in Making a Key

the gib head turned up in a single stroke of the side press. Two keys are completed at the same heat.

Because of the extreme simplicity of the operation, skilled

or experienced operators are not required and production varies from 1,200 to 1,600 finished keys per eight-hour day, depending upon the activity of the operator and the kind of stock being used. Rolls of a similar type but larger size are used for tapering brake levers, crow bars, tong handles and other similar tapered forged pieces.

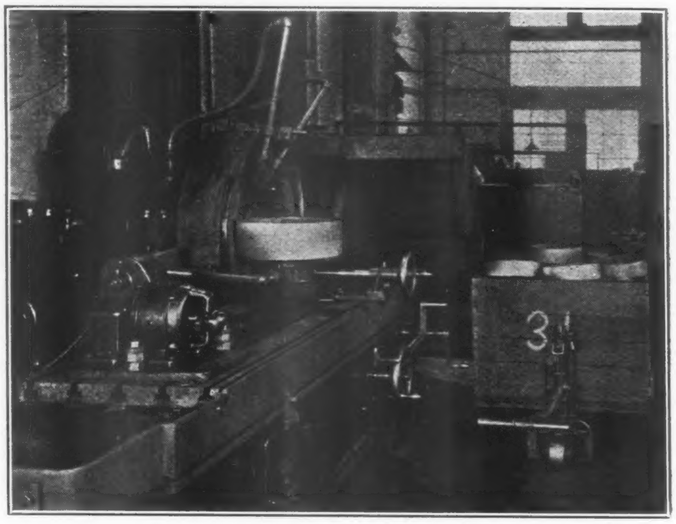
Improved Method of Crowning Pulleys

CROWNING pulleys by grinding is not new but the method described in this article differs from others by employing a special fixture for use on a Diamond heavy duty face grinding machine. If a pulley is rotated about its axis inside a cylindrical wheel, a crown is obtained varying from zero to one equivalent to the segment of a circle the diameter of the inside of the wheel (28 in.). It is even possible to obtain a negative crowning or concavity by rotating the pulley against the outside of the cylinder wheel. Such concavities are not of importance as far as pulleys are concerned but might be of value in other classes of work. The pulleys are, of course, chucked and the edges finished before placing on the fixture. Production will vary somewhat depending upon the amount of stock to be removed and the regularity of the castings.

The peculiar shape of the wheel when trued for this work gives a very efficient shearing effect against the face of the wheel, resulting in high production. Working on 12 in. diameter pulleys, 4 in. wide face, the average production time of two to three minutes per pulley, floor to floor, is readily obtainable.

The pulley grinding fixture, illustrated, consists of two units, a plate with a vertical spindle and an electric motor with reduction gearing. The vertical spindle is of suitable diameter to fit the hole in the hub of the pulley and a pin, serving as a driving dog is inserted between the spokes. The pulley is rotated by power and the feed adjusted by hand. With a small change the fixture can readily be adapted to webbed pulleys.

Pulley castings are usually very thin, often chilled, and frequently hard to machine. If machined on some types of lathes, low speeds and feeds are necessary and the percentage of breakage is high. Grinding offers the best solution of this as many other problems. The same principle can be success-

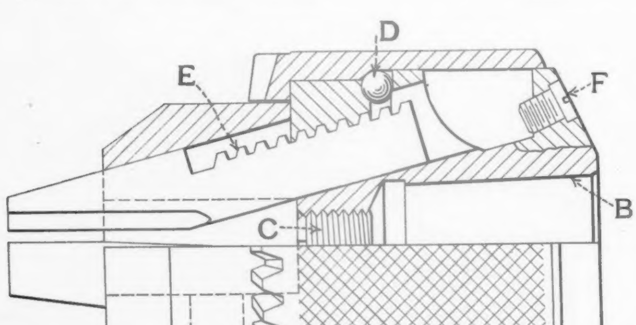


Diamond Pulley Grinding Attachment

fully applied to the grinding of malleable iron brake shoes, rollers for conveyors, wheels for small trucks and similar work. This pulley grinding fixture is made by the Diamond Machine Company, Providence, R. I.

Toothed Key and Sleeve Type Chuck

ACCURACY, ease of operation and durability are features that have been kept in mind in the design of the new chuck made by the Jacobs Manufacturing Company, Hartford, Conn. This chuck is of the toothed key



Jacobs Toothed Key Type Chuck

and sleeve type and is essentially the same as the chucks manufactured by this company for the past 18 years. The outward design has been changed slightly, however, to give better proportions as shown in the illustration.

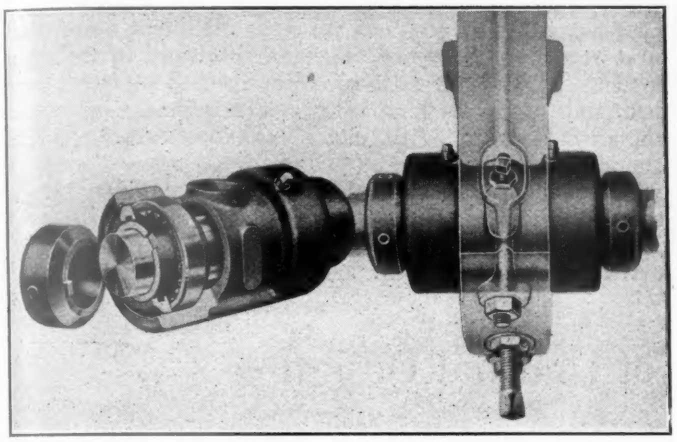
The body *A* is made of steel of a special analysis, deeply case hardened. Through a special process in this heat treating the taper hole *B* is left soft fitting it for use on a hardened and ground arbor. This taper hole is ground with great accuracy. A hole is drilled and tapped through the center of the body and fitted with a threaded plug *C* which may be easily removed with a screw driver if it is desired to insert rods or other material through the chuck. The taper hole on the chuck is of the same dimensions as those of previous designs. Each of the new chucks has been designed to meet the changed drilling methods of the last few years with relation to design, weight and capacity, all needless weight having been eliminated.

Ball bearings *D* inserted between the nut and the body reduce friction to a minimum making it possible to machine the thread *E* on the nut and the jaws with a coarser pitch than heretofore. Reduction of friction makes it possible to tighten the chuck with great ease, preventing undue wear on the keys, sleeves and other parts of the chuck at the same time giving greater gripping qualities.

An oil hole *F* inserted in the upper end of the chuck makes it possible to lubricate all of the working parts. One half the pressure on the key in tightening the chuck will produce the same results as in chucks of the previous design and the change in pitch of the thread on the jaws has resulted in reducing by one half the number of turns of the sleeve necessary to tighten or loosen the chuck.

Double Ball Bearing Hanger Boxes

REALIZING the large amount of power lost in shops and factories where the shafting runs on plain bearings, the Fafnir Bearing Company, New Britain, Conn., has developed a double ball bearing hanger box designed to reduce friction and power loss to a minimum. Reference to the illustration shows that in this box the driving collar and wide inner ring, exclusive features of the Fafnir Bearing, make the usual adapter sleeves unnecessary and thus eliminate trouble in maintaining these parts.



Phantom and Assembled View of Fafnir Shaft Hanger Box

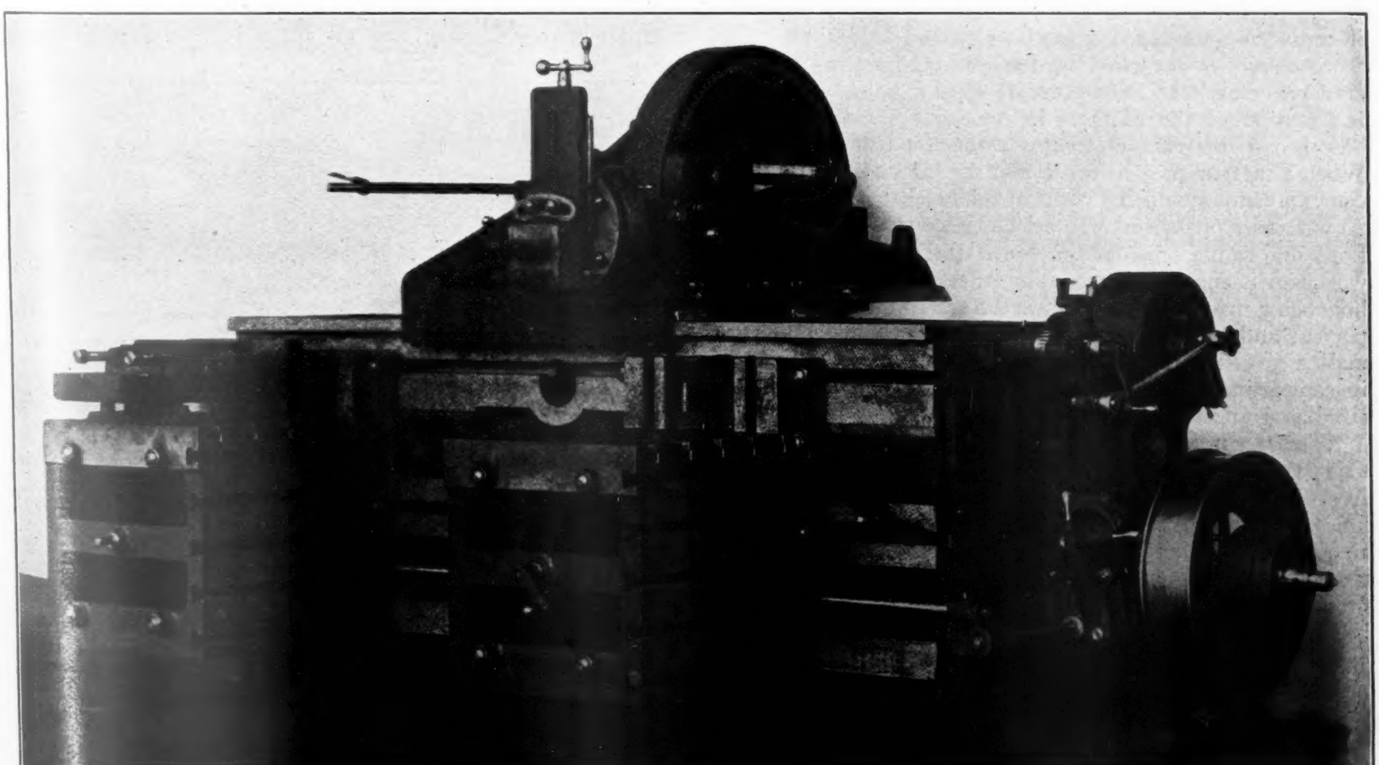
A collar is secured to the shaft at each end of the box by means of large set screws. The collar has lugs which mesh with corresponding slots cut in the inner ring of the ball bearing. Consequently the shaft, collar and inner ring revolve as a unit. Thus it will be appreciated that the collar drives the inner ring and transmits end thrust to the ball bearing. This construction makes it possible to ship each box completely assembled, and it can be put on the shaft as a unit, the driving collar being mounted on the shaft at each end of the box. There are no bolts or screws in the box to become loose and cause trouble; the wide inner rings of the ball bearings give the shaft ample support and provide a firm seat for the bearings; the box is supported in the middle and consequently any deflection of the shaft affects the box as a whole and does not interfere with the operation of the ball bearings.

Two ball bearings are installed in each box, being made of high-carbon, chrome alloy steel. The inner and outer rings and balls of these bearings are scientifically heat-treated and manufactured with extreme accuracy. Grease plugs are provided so that the bearings can be filled with grease when needed, which is not often. Felt packing rings prevent the lubricant from working out of the box. These double ball bearing boxes can be installed in any of the more common types of hangers.

Heavy Duty Traverse Head Shaper

THE Putnam Machine Works of Manning, Maxwell & Moore, Inc., Fitchburg, Mass., has recently added to its line of modern machine tools, a 26 in. traverse head shaper. While this shaper is a general purpose machine, adaptable to use in any machine shop, it is essentially a railroad shop tool, and can be provided with the necessary equipment for efficiently machining the faces of driving boxes, shoes and wedges, and many other miscellaneous locomotive parts.

The principal features of this shaper, as shown in the illustration, are its generally heavy proportions, ability to transmit the power required for heavy cuts at high speeds



General View of the Putnam 26-In. Traverse Head Shaper

and to absorb the strains incident thereto. Every effort has been made to secure maximum convenience of control. The bed of the shaper is of rigid construction with all bearing surfaces hand scraped. The head has a liberal bearing surface on the bed and is gibbed. There are ample facilities for taking up wear and wipers keep the surfaces in contact free from dirt and grit. Power feed for the head along the bed is by means of a large screw carrying a ratchet on its extreme end for engaging, disengaging or reversing of feeds ranging from .01 in. to .17 in.

An open and shut nut in the head provides ready means for disengagement with the feed screw when it is desired to quickly traverse the head along the bed by means of a ratchet handle provided. The ram is of a strong box construction with ample bearing surfaces and is operated by the McCord quick return motion which produces a practically uniform cutting speed. Facilities are provided for quickly and conveniently setting the ram to any stroke or position desired. The tables are mounted on individual saddles and have vertical adjustment by means of screws mounted on ball bearings. Longitudinal adjustment along the bed is accomplished by ratchet handles which are attached to the saddles. The construction provides for the application of a circular attachment, if desired.

Drive by belt or constant speed motor is so arranged that speed changes are readily obtainable through a selective type gear box, all gears of which are made of chrome nickel steel, heat treated and hardened. They are lubricated by the splash system. A powerful friction clutch is used, operated from both ends of the machine by conveniently placed levers, and the act of disengaging the clutch applies a brake for quickly stopping the ram. Drive by variable speed motor is arranged with sufficient speed changes by gearing to give suitable speeds to the ram. Beds 14 ft. and longer are usually made into double machines, having the two heads independently driven by separate 7½ hp. motors.

Internal Micrometer of Unusual Design

A RADICAL departure from the usual construction of internal micrometers is embodied in a new instrument made by John Bath & Company, Inc., Worcester, Mass. In this measuring tool, four measuring jaws are provided having true cylindrical contact surfaces which make a broad line contact with the walls of the hole being measured. The measuring jaws are accurately lapped and nicely fitted without play in dovetailed slots. Perfect alinement and parallelism of the jaws is secured. The jaws are moved up the flat inclined supporting surfaces on the solid body of the micrometer by a micrometer screw of exceptional accuracy. The result is an internal micrometer which is as rigid as a solid plug. It is made in 32 sizes which will give continuous measurements by ten-thousandths from ⅞ in. to 3 in.

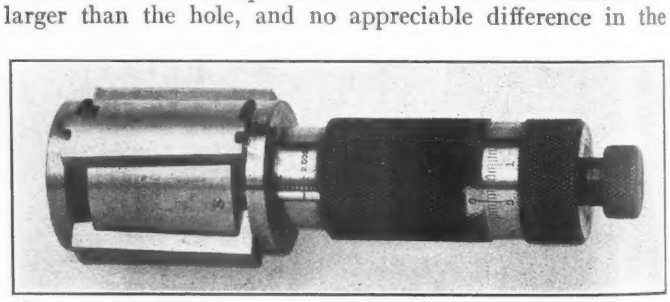
It is logical to measure cylindrical surfaces with a straight line contact, thus the use of the four parallel jaws with cylindrical contact surfaces, making a broad line contact with the internal cylindrical surface of a hole, gives uniformity in measuring machined, reamed or ground holes, and furthermore results in securing the limit of accuracy in measuring ring gages and the most accurate lapped holes. There is no indentation of the contacts in the surface being measured. The broad line contact secures at once a true measurement. When a measurement is taken and the jaws of the micrometer come in contact with the walls of the hole, they stop abruptly. Any number of persons will get the same result and the variations due to the sense of touch are, therefore, eliminated. A workman is enabled to ascertain quickly the exact size of the hole being machined. He knows the amount of metal removed per cut and all other conditions about the hole. This information gives him the assurance and ability to proceed rapidly in completing the work without risk of getting the hole over sized and adding to the spoilage loss.

A master reference ring gage, made by the John Bath Company, also departs from the usual form of construction. A deep wall section is provided with a series of concentric holes which have little effect in reducing the strength of the ring, but serve to reduce the weight materially and furthermore to provide for air circulation. This permits the ring to return more quickly to normal temperature after it has been heated or cooled. The construction of this master ring gage, therefore, results in securing maximum rigidity with minimum weight and the ability to expand and contract uniformly with changes of temperature.

Rules for Accurate Calipering

For accurate calipering, the surfaces of holes and of the micrometer should be washed with soap and water (preferably lukewarm water). This removes the grease, grit and all residue that may be left from gasoline, alcohol and other liquid and all sediment deposited from the atmosphere. After the contacting surfaces have been washed and thoroughly dried with a clean cloth or with new clean tissue paper, the micrometer is inserted in the hole and the jaws expanded until they are stopped by the walls of the hole, thus measuring the exact size of the lapped hole.

After having found the exact size of a hole, with the surfaces clean and dry, it is astonishing to note the changes which take place when oil or lubricant is present. Oil of any nature reduces the friction which caused the screeching and jerky movement, found when the micrometer was rotated in the ring, clean and dry. Oil makes the rotation of the micrometer smooth, and with oil present it is no longer possible to distinguish the large diameters from the small diameters; the high points from the low points. Furthermore, the micrometer can be expanded to be several ten-thousandths larger than the hole, and no appreciable difference in the force required to rotate the micrometer will be noticed. Oil entirely destroys "feel."



The 2-In. Bath Internal Micrometer

An excellent way to detect small irregularities such as depressions, high spots and slight conditions of bell mouth or taper in a lapped hole is to make use of a very thin film containing sediment or residue deposited from the air. If a lapped ring gage is first coated with castor oil, the excess oil being removed by vigorous rubbing with a clean cloth and the gage is allowed to stand for several hours, dust particles from the air will be deposited on the trace of oil left in the ring. A micrometer rotated in a ring treated in the foregoing manner develops a very thin brownish colored film by which it is possible to detect minute irregularities in holes. It is said that with the new Bath micrometer internal measurements can be made even more accurately and rapidly than external measurements with the usual form of micrometer.

Railway Mechanical Engineer

(*Formerly the* RAILWAY AGE GAZETTE, MECHANICAL EDITION *with which the* AMERICAN ENGINEER *was incorporated*)

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WE GUARANTEE, that of this issue 9,200 copies were printed; that of these 9,200 copies, 8,261 were mailed to regular paid subscribers, 8 were provided for counter and news company sales, 263 were mailed to advertisers, 32 were mailed to employees and correspondents and 628 were provided for new subscriptions, samples, copies lost in the mail and office use; that the total copies printed this year to date were 49,400, an average of 9,880 copies a month.

The *Railway Mechanical Engineer* is a member of the Associated Business Papers (A. B. P.) and the Audit Bureau of Circulations (A. B. C.)

Four locomotives were burned in a fire of undetermined origin which recently destroyed the roundhouse and machine shops of the Maine Central at Calais, Me.

W. O. Thompson, secretary of the Traveling Engineers' Association, has changed his headquarters from Buffalo, New York, to 1177 East Ninety-eighth street, Cleveland, Ohio.

The Transportation Club, Buffalo, N. Y., has appointed the following officers for the year 1921: Kendall B. Hassard, president; Judson M. Sells, first vice-president; Godfrey Morgan, second vice-president; Redmond J. Walsh, secretary and treasurer, and George C. Wilson, assistant secretary.

The United States Civil Service Commission has announced an open competitive examination for shop apprentices. Vacancies in the Bureau of Standards at $720 a year and positions requiring similar qualifications will be filled from this examination. Applications will be received by the commission at Washington, until August 1, 1921.

The Southern Pacific has recently completed a first aid station or emergency hospital at Bay Shore, South San Francisco shops, which makes the thirteenth emergency hospital unit on the company's Pacific system. The unit has an operating room, small ward, kitchen, waiting room and doctor's office, and the station is in charge of a trained nurse at all times.

Ninety miles in one hour and twenty minutes was the time made by a special train of two cars from Philadelphia to Jersey City on the afternoon of April 18, over the Philadelphia & Reading and the Central of New Jersey, a speed equal to 67.5 miles an hour. This train was run for J. L. Stokes, a banker, to enable him to connect with a train for Montreal, the Pennsylvania being blocked by a derailment and the Reading having no regular train for two hours. Mr. Stokes paid for the train $427.

Master Boiler Makers' Convention Deferred

The executive board of the Master Boiler Makers' Association has voted to defer the annual meeting which was scheduled to have been held at St. Louis, Mo., May 23 to 26.

Storekeepers' Annual Meeting

The Division of Purchases and Stores of the American Railway Association (Division VI) will hold a convention in Chicago, at the Hotel Blackstone, on Thursday, Friday and Saturday, June 9, 10 and 11.

General Secretary J. E. Fairbanks has issued a circular which says that the general committee of this Division, because of the financial stress and serious business conditions, has determined that it is necessary to defer the annual convention scheduled for Atlantic City. The Chicago meeting will be strictly for business. The sessions will convene at 10 a. m., city time. The general committee and standing committees will be in attendance. Members are requested to have such representatives of their supply departments attend as can conveniently do so. The meeting will consider Committee reports which are ready and will formulate a constructive plan for the future activities of the Division.

Machine Tool Builders Cancel Convention

The National Machine Tool Builders' Association announces that its spring convention, scheduled for May 19 and 20 at Atlantic City, N. J., is cancelled.

American Society for Testing Materials

The American Society for Testing Materials will hold its twenty-fourth annual meeting at the New Monterey Hotel, Asbury Park, N. J., on June 20 to 24, inclusive. Monday, June 20, will be devoted to committee meetings, and the first session of the annual meeting will be held on Tuesday morning, June 21.

Shop Construction

ATCHISON, TOPEKA & SANTA FE.—This road has awarded the contract for the construction of a blacksmith shop, 80 ft. by 307 ft., at San Bernardino, Cal., to Joseph E. Nelson & Sons, Chicago. The estimated cost is $150,000 and construction will commence at once.

Locomotives

The PEKIN-MUKDEN has ordered 19 locomotives from English builders.

The ATCHISON, TOPEKA & SANTA FE has ordered 10 Pacific, 15 Mikado, 15 Mountain and 10 Santa Fe type locomotives from the Baldwin Locomotive Works.

NATIONAL RAILWAYS OF MEXICO.—The General Equipment Company, New York, has sold to The Oliver American Trading Company, with New York City office at 61 Broadway, 65 rebuilt locomotives, including Mogul, 10-wheel and Consolidation type locomotives for use over the lines of the National Railways of Mexico in connection with the operation of the private freight trains of the Oliver company. This company, in addition to these 65 locomotives just purchased, also has leased 20 locomotives from American railroads, which, with the equipment they are now operating, gives it a total motive power of about 95 locomotives. This sale of the General Equipment Company has been made possible by virtue of certain arrangements between Senor Francisco Perez, Director-General of the National Railways of Mexico and

The Oliver American Trading Company, Inc., which plan provides a practical means of financing this equipment.

Freight Cars

THE DELAWARE, LACKAWANNA & WESTERN is having repairs made to 1,000 box cars at the Berwick shops of the American Car & Foundry Co. This is in addition to the 1,000 cars on which repairs were authorized to be made at the same plant last October.

THE ATCHISON, TOPEKA & SANTA FE has ordered 1,000 50-ton gondolas from the American Car & Foundry Co.; and 300 50-ton gondola cars from Haskell & Barker Car Co., Inc.

The UNITED FRUIT COMPANY, New York, has ordered 50 all steel ballast cars for the Pruxillo Railroad, Honduras, from the Magor Car Company.

The BEACON OIL COMPANY, Boston, Mass., has ordered 20 tank cars, of 10,000 gal. capacity, from the General American Tank Car Corporation.

MEETINGS AND CONVENTIONS

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs:

AIR-BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City.

AMERICAN RAILWAY ASSOCIATION, DIVISION V—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Business meeting June 15 and 16, Hotel Drake, Chicago, Ill.

DIVISION V—EQUIPMENT PAINTING DIVISION.—V. R. Hawthorne, Chicago.

AMERICAN RAILWAY ASSOCIATION, DIVISION VI—PURCHASES AND STORES.—J. P. Murphy, N. Y. C., Collinwood, Ohio. Convention June 9, 10 and 11, Hotel Blackstone, Chicago, Ill.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago. Convention September 12-14, Hotel Sherman, Chicago, Ill.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, 1145 E. Marquette Road, Chicago. Convention August 9, 10 and 11, Hotel Sherman, Chicago, Ill.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa. Annual meeting June 20 to 24, inclusive, New Monterey Hotel, Asbury Park, N. J.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Spring meeting May 23 to 26, inclusive, Congress Hotel, Chicago, Ill.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio. Annual convention September 19-24, Indianapolis, Ind.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill.

CANADIAN RAILWAY CLUB.—W. A. Booth, 131 Charron St., Montreal, Que. Next meeting May 10. Annual meeting. Reports, smoker and entertainment.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Meeting second Monday in month, except June, July and August, New Morrison Hotel, Chicago, Ill.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—Thomas B. Koeneke, 604 Federal Reserve Bank Building, St. Louis, Mo. Meetings first Tuesday in month at the American Hotel Annex, St. Louis, Mo.

CENTRAL RAILWAY CLUB.—H. D. Vought, 95 Liberty St., New York, N. Y. Next meeting May 12. Paper on the Manufacture of High Speed Steel will be presented by Felix Kremp, metallurgist, Atlas Crucible Steel Company, Dunkirk, N. Y.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. P. Elliott, T. R. R. A. of St. Louis, East St. Louis, Ill.

CINCINNATI RAILWAY CLUB.—W. C. Cooder, Union Central Building, Cincinnati, Ohio. Next meeting May 10. Paper on Experiences in Mexico will be presented by P. G. O'Hara, of the Galena Signal Oil Company. Entertainment by George J. Breiel, Cincinnati Regalia Company.

DIXIE AIR BRAKE CLUB.—E. F. O'Connor, 10 West Grace St., Richmond, Va.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 715 Clarke Ave., Detroit, Mich. Next meeting August 16, 17 and 18, 1921, Hotel Sherman, Chicago, Ill.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 702 East Fifty-first St., Chicago, Ill. Next annual meeting, May 24-26, 1921, Hotel Sherman, Chicago, Ill.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn. Convention, September 12, 13, 14 and 15, 1921, Hotel Sherman, Chicago, Ill.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York, N. Y.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Next meeting May 10. Paper on New England, Its Rivers, Mountains and Seashore, will be presented by E. S. Jones, official photographer, Boston & Maine, and will be illustrated by lantern slides.

NEW YORK RAILROAD CLUB.—H. D. Vought, 95 Liberty St., New York, N. Y.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Building, Buffalo, N. Y.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Meeting second Thursday in month, alternately in San Francisco and Oakland, Cal.

RAILWAY CLUB OF PITTSBURGH.—J. D. Conway, 515 Grandview Ave., Pittsburgh, Pa. Meetings fourth Thursday in month except June, July and August, Americus Club House, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Next meeting May 6. Moving pictures and lecture on Thunder Bay to the Skeena River will be given by Capt. J. Milton State.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—Bruce V. Crandall, 14 E. Jackson Boulevard, Chicago. Annual meeting May 16.

PERSONAL MENTION

GENERAL

M. B. MCPARTLAND has been appointed superintendent of motive power of the Denver & Salt Lake with headquarters at Denver, Colo., succeeding J. J. Connors, resigned on account of ill health.

O. P. REESE, superintendent of motive power of the Pennsylvania, Northwestern Region, with headquarters at Toledo, has been transferred to Chicago, succeeding O. C. Wright, assigned to other duties.

E. J. SUMMERS, smoke inspector of the Chicago, Milwaukee & St. Paul, has been promoted to fuel supervisor, with jurisdiction over the system, and headquarters at Chicago.

JOHN P. KELLY, for the past two years inspector of safety appliances in the Bureau of Safety, Interstate Commerce Commission, has been appointed senior railway mechanical engineer for that Bureau, with headquarters at Washington, D. C. Mr. Kelly was born in Great Barrington, Mass., on March 16, 1864, and received his early education in the public schools of that town; his engineering training was obtained in the engineering departments of the companies by whom he was employed. His first railroad service was on the Housatonic Railroad, now a part of the New Haven System, as water boy on passenger trains, in 1880. He was locomotive fireman in 1884, and locomotive engineman in 1887. He served as locomotive engineman on the New Haven and later on the New York Central; and in 1898 was appointed air brake instructor on the Central. In 1899 he was road foreman of engines on the Chicago & Alton; in 1901 he went to the New York Air Brake Company, where later he was appointed assistant mechanical engineer. In 1905 he resigned and went to the Westinghouse Air Brake Company but in 1910 resigned and devoted his time to the business of consulting air brake engineer, and to writing for the technical press. In 1912 he entered the employ of the New York Central Lines as consulting air brake engineer. Later he went into government employ as above stated.

J. P. Kelly

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

F. A. GIBBS has been appointed terminal road foreman of engines of the Atchison, Topeka & Santa Fe at Redondo Junction, Cal.

L. W. GILBERT has been appointed road foreman of engines of the Santa Fe at La Junta, Colo., succeeding C. A. Mays, assigned to other duties.

J. B. MERRITT has been appointed road foreman of engines on the Second district of the New Mexico division of the Atchison, Topeka & Santa Fe, with headquarters at Raton, N. M., succeeding J. T. STUVORT, who has been transferred to the Third district.

GUY P. MOHLER has been appointed terminal road foreman of engines of the Santa Fe at Needles, Cal., succeeding Earl Gilbert, transferred.

T. A. ROUSSIN has been appointed master mechanic of the Missouri-Illinois which has been organized, with general headquarters at Bonne Terre, Mo., to take over the operation of the Illinois Southern. Mr. Roussin is located at Sparta, Ill.

CAR DEPARTMENT

Albert J. Krueger, whose appointment as master car builder of the New York, Chicago & St. Louis was announced in the March issue of the *Railway Mechanical Engineer,* was born on June 26, 1890, at Toledo, Ohio. He attended the Toledo High School and in 1908 entered the employ of the Lake Shore & Michigan Southern, later known as the New York Central. After serving successively as car repairer, car inspector, repair work inspector, piece work inspector, contract shop inspector, assistant general shop inspector and general shop inspector until December 1, 1916, Mr. Krueger entered the service of the Nickel Plate Road as general shop inspector and remained in this position until his recent appointment.

SHOP AND ENGINEHOUSE

Edward Bickerton has been appointed general foreman of the Canadian National Railways, with headquarters at Port Arthur, Ont.

Coincident with the consolidation of divisions on the Chicago, Rock Island & Pacific, appointments and transfers have been made as follows: G. M. Stone, master mechanic, with headquarters at Manley, Iowa, has been appointed general foreman, with the same headquarters. B. H. Smith, master mechanic, with headquarters at Fairbury, Neb., has been appointed general foreman, with the same headquarters. W. E. Danver, master mechanic, with headquarters at Amarillo, Tex., has been appointed road foreman of equipment, with the same headquarters. A. Hambleton, master mechanic, with headquarters at El Dorado, Ark., has been appointed general foreman, with headquarters at Shawnee, Okla.

H. M. Cooper has been appointed roundhouse foreman of the Santa Fe at Winslow, Ariz.

Charles Loud has been appointed assistant roundhouse foreman of the Atchison, Topeka & Santa Fe, at Las Vegas, N. M.

Minden McGee has been appointed foreman of the Santa Fe at Lamy, N. M., succeeding W. H. Sapp, transferred.

G. T. De Pue, mechanical superintendent of the Erie, with headquarters at Chicago, has been appointed shop superintendent at Galion, Ohio. The office of mechanical superintendent at Chicago has been abolished.

PURCHASING AND STOREKEEPING

J. F. Blasie has been appointed district storekeeper of the New York Central at Depew, N. Y., succeeding H. L. Grandy, transferred.

A. Herrera, formerly purchasing agent of the National Railways of Mexico, with headquarters at Mexico City, has been appointed to his former position. Mr. Herrera was born September 16, 1878, at Mexico City. He was educated at the Merchants' School of that city and entered railway service March 1, 1895, with the Mexican Central. After serving in several minor positions in the stores department he was appointed chief clerk of that department in 1901. In 1903 he was promoted to material accountant and served in that capacity until 1906 when he was appointed fuel agent. In 1909 when the Mexican Central was incorporated into the National Railways of Mexico, Mr. Herrera's duties were extended to include the maintenance of the fuel service of the entire system. In 1910 he was appointed purchasing agent. Mr. Herrera continued in this position until 1915 when, because of the revolution, he retired to private life. With the return of normal conditions he has again resumed the duties of his office.

A. Herrera

C. A. Dougherty, assistant district storekeeper of the New York Central at Elkhart, Ind., has been appointed storekeeper at Englewood, Ill., succeeding C. E. Shoup.

G. A. Goerner of the Chicago, Burlington & Quincy has been relieved of special duties assigned to him some time ago, and reappointed storekeeper at Clyde, Ill.

L. J. Green, formerly assistant general storekeeper of the New York Central at West Albany, N. Y., has been appointed storekeeper at Otis, N. Y., succeeding F. C. Vroman.

B. W. Griffeth, former assistant general storekeeper of the New York Central at Collinwood, Ohio, has been appointed district storekeeper, third district, with headquarters at Collinwood. Mr. Griffeth succeeds F. J. McMahon, who has been assigned other duties in the stores department at the same point.

R. S. Huffman, assistant general storekeeper of the New York Central at West Albany, N. Y., has been appointed district storekeeper, with headquarters at the same point, succeeding J. H. Seim, transferred.

W. H. King, Jr., assistant to the vice-president in charge of operation of the Seaboard Air Line, has been appointed general purchasing agent, and will succeed H. C. Pearce who has resigned.

A. L. Prentice has been appointed district storekeeper of the New York Central, with headquarters at Elkhart, Ind., succeeding C. F. Heidenrich, who has been transferred to Collinwood, Ohio, in the stores department.

J. B. Taylor has been appointed stores accountant of the Cleveland, Cincinnati, Chicago & St. Louis at Beech Grove, Ind., succeeding R. H. Kroger, assigned to other duties.

OBITUARY

F. V. McDonnell, master mechanic of the Northwestern Region of the Pennsylvania, with headquarters at Ft. Wayne, Ind., died on April 26.

Riley Laizure, formerly master mechanic of the New York, Chicago & St. Louis at Conneaut, Ohio, died February 24, 1921, at the age of 71 years, having been retired on a pension for one year. He is survived by a wife and three sons, one of whom, Lee R. Laizure, is now master mechanic for the Erie Railroad at Secaucus, N. J. Mr. Laizure was born in Steubenville, Ohio, and at the age of fifteen began work as a blacksmith apprentice at $9 per month, in a shop furnishing track tools for the Pennsylvania Railroad. After serving some time in the railroad shop at Denison, Ohio, he worked in the blacksmith shop of the Louisville & Nashville at Louisville, Ky., and left there during the panic of 1873 to enter the employ of a manufacturing company at Columbus, Ohio. Returning to railroad service, Mr. Laizure worked for the Pennsylvania Railroad and was one of the pioneers in the blacksmith shop department of the Erie Railroad. He worked for the Atlantic and Great Western at Galion, Ohio, when the gage was changed from broad to standard, and in later years served the Erie as blacksmith foreman at Susquehanna and Meadville. Returning to the industrial field in 1893, several years were spent directing blacksmith shop work for the American Locomotive Company at Richmond, Va., to be followed by 15 years as master blacksmith of the Nickel Plate at Conneaut, Ohio. Mr. Laizure was a mechanic of the old school, a well-known figure at the annual conventions of the International Railroad Master Blacksmiths' Association and highly esteemed by all those who knew him.

R. Laizure

SUPPLY TRADE NOTES

E. E. Goodwillie has been appointed sales agent in charge of the Cleveland office of the Bethlehem Steel Company, Bethlehem, Pa.

The G. M. Basford Company has removed its office from 30 Church street to the National City building, 17 East forty-second street, New York City.

The Rome Iron Mills, Inc., has removed its general offices from 30 Church street to the National City building, 17 East Forty-second street, New York City.

The Landis Tool Company, Waynesboro, Pa., has removed its New York sales office from 50 Church street to 51 Chambers street. M. G. Dunbar is the manager.

The Stone Franklin Company has removed its general offices from 30 Church street to the National City building, 17 East Forty-second street, New York City.

The Superheater Company removed its general offices on May 1 from 30 Church street to the National City building, 17 East Forty-second street, New York City.

The American Arch Company, Inc., has removed its general offices from 30 Church street to the National City building, 17 East Forty-second street, New York City.

The Franklin Railway Supply Company, Inc., has removed its general offices from 30 Church street to the National City building, 17 East Forty-second street, New York City.

Ralph T. Hatch has been appointed general manager of sales for the Reading Steel Castings Company, a subsidiary of the American Chain Company, with headquarters at Reading, Pa. Mr. Hatch entered railroad sales work with the B. F. Goodrich Rubber Company at Akron, Ohio, and was for several years railroad representative of this company. For the past 14 years he has been connected with the sales department of the National Malleable Castings Company, serving this company first as manager of Canadian sales with headquarters at Montreal, Can., and later going to the Chicago office of the company. At the time of his recent appointment he was serving as district manager of sales for the Northwestern territory, with headquarters at St. Paul, Minn., a position he had held for several years.

Ralph T. Hatch

The Universal Crane Company, Cleveland, Ohio, announces the removal of its plant from Cleveland, Ohio, to its new factory at Elyria, Ohio, which has recently been completed.

The Hutchins Car Roofing Company. Detroit, Mich., removed its New York City office on May 1 from 103 Park avenue to room 910 Canadian Pacific building, 342 Madison avenue.

The Lima Locomotive Works, Inc., has removed its executive and sales offices from 30 Church street to the National City building, 17 East Forty-second street, New York City.

The Railway Materials Company announces that on May 1 its general offices were moved from the Railway Exchange to suite 1900, Wrigley building, 400 North Michigan avenue, Chicago.

The Victor Tool Company, Inc., Waynesboro, Pa., has opened a branch office at 131 West Thirty-ninth street, New York, in charge of F. W. Curtis, manager, and Warren J. Boe, sales engineer.

The Gold Car Heating & Lighting Company on May 1 removed its offices from 17 Battery Place, New York City, and its warehouse to larger quarters at the Bush Terminal, 220 Thirty-sixth street, Brooklyn, N. Y.

The Standard Paint Company on April 1 changed its corporate title to the Rubberoid Company. There will be no change in the management or policy of the company, whose general offices will remain at 95 Madison avenue, New York.

Max Grant, whose appointment as manager of technical railway sales of the Glidden Company, Cleveland, Ohio, was announced in the March *Railway Mechanical Engineer,* was born in Berlin, Germany, in 1876. After serving for three years in the paint business in Germany he came to America in 1896, and went to the Devoe-Raynolds Company, serving first at Chicago and then at New York. About five years later he was appointed superintendent and later became manager of the Canton Paint & Varnish Company, Canton, Ohio. In 1910, he was appointed manager of the railroad paint department of the Wrinkle Paint Manufacturing Company, Columbus, Ohio, and since 1915, was manager of the railway paint department of the Tropical Paint & Oil Company, Cleveland, until his recent appointment as manager of technical railway sales of the Glidden Company with headquarters at Cleveland.

M. Grant

The W. T. Dunn Co., 10 High street, Boston, Mass., has been appointed New England sales agent for B. M. Jones & Co., Inc., 192 Chambers street, New York, importer of Mushet and Titantic tool steels, and Taylor's best Yorkshire iron.

Charles M. Chamberlin, secretary and director of A. M. Castle & Co., Chicago, for the past 20 years, retired from all active business associations on April 1. Fred C. Conners has been elected a director and secretary to succeed Mr. Chamberlin.

J. J. Connors, until recently superintendent of motive power of the Denver & Salt Lake, has formed a connection with the Lowe Brothers Company, Dayton, Ohio, as railway representative, with office at 1243 Monadnock building, Chicago, Ill.

The E. Horton & Son Company, Windsor Locks, Conn., has bought the chuck business of the American Company, Hartford, Conn. The American Company has specialized in the manufacture of a 3-jaw geared drill chuck known as the Ellison chuck.

The Modern Tool Company announces arrangements whereby the E. L. Essley Machinery Company, 551 Washington boulevard, Chicago, becomes exclusive selling agents in the Chicago territory for Modern plain and universal grinding machines.

The offices of the Pocket List of Railroad Officials and the official Railway Equipment Register, published by the Railway Equipment and Publication Company, have been removed from 75 Church street to larger quarters at 424 West Thirty-third street, New York.

Allan A. Ryan has resigned as a director of the Chicago Pneumatic Tool Company, New York, and also as a director of the Vanadium Corporation of America. Mr. Ryan has

been succeeded on the board of the latter company by T. M. Schumacher, president of the El Paso & Southwestern System.

The Pressed Steel Car Company, Pittsburgh, Pa., removed its New York office on May 1, from 24 Broad street, to the Seaboard National Bank Building, corner of Broad and Beaver streets. The stockholders of this company at a recent meeting ratified an increase of capitalization from $25,000,000 to $50,000,000.

F. W. McIntyre has been appointed general sales manager of the Reed-Prentice Company and the Whitcomb-Blaisdell Machine Tool Company, Worcester, Mass., also the Becker Milling Machine Company, Hyde Park, Boston, succeeding J. P. Ilsley, who has resigned to go with the Taylor Steel Construction Company, New York.

Robert Alexander Bole, vice-president, director and district sales manager of Manning, Maxwell & Moore, Inc., New York, died on April 2, at the age of 62, in the Schenley Hotel, Pittsburgh, where he made his home. Mr. Bole was widely known in the iron, steel and railroad circles. He was born in Old Allegheny City, and received his education in the Pittsburgh schools. In early life he became identified with the Westinghouse Machine Company and rose from the ranks to secretary of that company. Following his long service with the Westinghouse interests, he became identified with the manufacturing company of Niles-Bement-Pond Company, New York, and resigned from that company to become associated with Manning, Maxwell & Moore, Inc. At the time of his death, he had been identified with the latter company for a period of 26 years.

R. A. Bole

Robert B. M. Wilson, sales engineer in the Indiana district for the Conveyors Corporation of America, Chicago, has been appointed sales engineer of the Chicago district, and E. W. Wolfe, who has been for several years with the company in a sales capacity, becomes an assistant to Mr. Wilson, with headquarters in the corporation's main office at 326 West Madison street.

Frank N. Grigg has been appointed southeastern sales manager of the Morton Manufacturing Company, with headquarters at 630 Louisiana avenue, Washington, D. C. Mr. Grigg will handle the sale of the entire "Acme Line" of railway appliances. C. H. Kadie, formerly master mechanic on the Southern Railway, is now in the sales department of this company and will assist Mr. Grigg.

William T. Lane, district manager of the Pacific Coast territory of the Franklin Railway Supply Company, Inc., New York, has been transferred from San Francisco to Cleveland, Ohio, as district manager of the Cleveland territory, and James McLaughlin, assistant to the vice-president at Chicago, has been transferred to San Francisco as district manager of the Pacific Coast territory to succeed Mr. Lane.

W. H. Noble has been appointed district manager at Chicago of the Texas Company, Houston, Texas, succeeding John J. Flynn, deceased. Offices have been opened at St. Louis, Mo., 1689 Arcade building, with F. E. Sheehan, representative in charge; Los Angeles, Cal., 1206 Merchants National Bank building, with J. B. Flynn, representative in charge, and at Oklahoma City, Okla., with L. R. Dallam, representative in charge.

The Cincinnati Grinder Company, Cincinnati, Ohio, has recently placed the sale of its line of grinding machines on an exclusive basis with the Marshall & Huschart Machinery Company in the Chicago district; Motch & Merryweather Machinery Company in the Cleveland, Cincinnati, Pittsburgh and Detroit district; Henry Prentiss & Co. in the New York and New England district, and will also maintain its own grinding specialists in the respective territories.

The W. R. Hickman Lumber Company has been organized in Cleveland, Ohio, with W. R. Hickman, for the past five and a half years sales manager for the Nicola Stone & Myers Company, as president. The company will specialize in railroad and industrial lumber, handling yellow pine, West Coast stock, ties and hardwood car material. The general offices of the company are at 1264 Hanna building, Cleveland, Ohio, with representatives in Hattiesburg, Miss., and Seattle, Wash.

The Lilly Varnish Company, Indianapolis, Ind., has been sold to an organization consisting of C. M. Malott, president; C. F. Brigham, vice-president and general manager; C. F. Hackathorn, vice-president in charge of manufacture and purchases, and W. I. Longsworth, secretary and sales manager. Mr. Malott is also president of the Indianapolis Paint & Color Company. William Lilly, who has managed the Lilly Varnish Company for a long time, will remain with the new organization as treasurer.

The Fosdick Machine Tool Company, Cincinnati, Ohio, have taken over all patents, drawings, patterns, jigs and fixtures covering the line of Pierle quick change high speed ball bearing sensitive drill presses, from the R. K. Le Blond Machine Tool Company. This acquisition by the Fosdick Machine Tool Company will give them a complete line of drilling machinery, consisting of heavy duty radial drills, heavy duty upright and gang drills, and high speed sensitive single and multiple spindle drills.

H. Kirke Porter, president of the H. K. Porter Company, Pittsburgh, Pa., died on April 10, at his home in Washington, D. C. He was born on November 24, 1840, at Concord, N. H., and studied at Newton Theological Institute and at Rochester Theological Seminary. He enlisted with the 45th Massachusetts Volunteers in 1862, and was mustered out of service in July, 1863. Mr. Porter served in the United States Christian Commission during the winter of 1864, and began his business life in 1866, as a member of the firm of Smith & Porter, manufacturing exclusively light locomotives. In 1871 the firm became Porter, Bell & Company. In 1879 it was changed to H. K. Porter & Co., and in 1899 was incorporated under the name of the H. K. Porter Company. During the past 20 years, the firm has been engaged in manufacturing heavy as well as light locomotives. This concern was the first to make compressed air locomotives for mine and general industrial use. Mr. Porter was a member of the 58th Congress from 1903 to 1905.

H. K. Porter

The Air Reduction Sales Company, Inc., manufacturers of Airco oxygen, acetylene and welding and cutting apparatus, moved its executive offices on May 1, from 120 Broadway to 342 Madison avenue, New York City. The New York district office at 160 Fifth avenue, New York, is now located at the Airco factory, 191 Pacific avenue, Jersey City, N. J. The company has secured control of the National Carbide Corporation of Virginia, with a new plant at Ivanhoe, Va., and will direct the policy and control the operation and sales of the Carbide Corporation.

The Elliott Company, Jeannette, Pa., announces the following changes in the company's sales organization: W. A. Darrow,

who has been district sales manager of the Philadelphia office for the past ten or fifteen years, has been appointed special representative, with headquarters at Philadelphia. T. F. Crawford, St. Louis district sales manager, has been transferred to the Philadelphia office in the same capacity. C. L. Draper, of the Kansas City office, has been made district sales manager of the St. Louis office, and M. C. Sickels, of the Cleveland office, has been made Cleveland district sales manager, succeeding D. S. Tucker. All of the above will have charge of the sale of the products of the Lagonda Manufacturing Company, Springfield, Ohio, and the Liberty Manufacturing Company, Pittsburgh, in addition to those of the Elliott Company.

E. E. Hudson, vice-president and general manager of the Waterbury Battery Company, Waterbury, Conn., has been elected president of the company to succeed Charles B. Schoenmehl, deceased, and Francis T. Reeves has been elected treasurer. Mr. Hudson for the past 22 years, with the exception of a little over a year's time, has been in the sales and managerial departments of concerns manufacturing primary batteries and has been identified with the installation of the primary battery. In July, 1898, he served as chief clerk in the primary battery sales department of the Edison Manufacturing Company, remaining in that position until June, 1902. Shortly afterward, he served as an accountant in the controller's department of the United States Steel Company. In December, 1903, he became secretary and treasurer of the Battery Supplies Company, Newark, N. J., and in 1905 was appointed sales manager of that company. When the Edison company absorbed the Battery Supplies Company, in 1908, he was appointed assistant manager of sales in the primary battery department. He became sales manager of that department in February, 1909, and in September, 1913, was elected also vice-president. In October, 1914, in addition to these duties, he was given charge of the manufacturing, as well as the sales, and in March, 1915, was made division manager in general charge of the entire primary battery business of Thomas A. Edison, Inc. In 1914, he was chairman of the Railway Telephone & Telegraph Appliance Association and in 1916, he was chairman of the Signal Appliance Association, previously having been a director. He also served for seven years as a director of the National Appliance Association, which is to the American Railway Engineering Association what the Signal Appliance Association is to the Railway Signal Association. On January 1, 1917, he was elected vice-president and general manager of the Waterbury Battery Company and now becomes president of the same company.

Ralph G. Coburn, president of the Stone Franklin Company, New York, has been elected also a vice-president of the Elvin Mechanical Stoker Company with headquarters at 50 Church street, New York, and E. W. Englebright, who became associated with the Elvin Mechanical Stoker Company in December, 1920, has also been elected a vice-president of that company. Mr. Coburn was born in Boston in 1882 and was graduated from Harvard in 1904. He then served, until 1909, with the American Glue Company in charge of its western territory, with headquarters at Des Moines, Iowa, and Chicago. On May 1, 1909, he opened the Chicago office of the Franklin Railway Supply Company as resident sales manager and in June, 1911, was appointed assistant to the vice-president in charge of eastern-southern territory, with headquarters at New York. In December, 1913, he was appointed eastern sales manager of the same company. In May, 1919, the Stone Franklin Company, New York, was organized to market the Stone Franklin car lighting system in the United States and Canada and Mr. Coburn was elected president of the new company, which position he retains in addition to his new duties as vice-president of the Elvin Mechanical Stoker Company.

R. G. Coburn

TRADE PUBLICATIONS

GRINDING AND POLISHING MACHINERY.—The Webster & Perks Co., Springfield, Ohio, has issued a catalogue made up of various bulletins which describe the different types of ball bearing and plain grinding and polishing machinery which they manufacture. An illustration of each machine and specifications are included.

FOUNDRY PRACTICE.—A very complete handbook on foundry practice has been issued recently by the Farrell-Cheek Steel Foundry Company, Sandusky, Ohio. The book, which is printed in four colors, not only describes, but illustrates profusely each operation required in the making of a casting, the same casting or pattern being used throughout.

REAMERS AT WORK.—Under this title the Gisholt Machine Company, Madison, Wis., has issued an eight-page, illustrated booklet describing a solid adjustable Gisholt Reamer. This reamer is made in three body types: namely, shell reamer, straight shank machine reamer, and paper shank machine reamer. A size and price list is included in the catalogue.

HORIZONTAL RETURN TUBULAR BOILERS.—The Bigelow Company, New Haven, Conn., has reprinted in a separate book matter relating to their return tubular boilers and appearing in the company's regular catalogue. This includes a general description of this type of boiler, detailed instructions for setting, illustrations of boilers and furnaces and comprehensive tables of data.

FLANGE OILER.—Catalogue No. 4 issued by the Hoofer Manufacturing Company, Chicago, contains 12, 5 in. by 8 in. pages devoted to a description of the Hoofer pneumatic flange oiler. A complete description of the construction and operation of this device is accompanied by suitable illustrations. A detailed illustration of the application of the lubricator, piping, control valve and oil distributors also is included.

RAILROAD SHOP GRINDING.—Under the title Grinding in Railroad Shops the Norton Company, Worcester, Mass., has recently issued a small 28-page booklet on this subject. The material is very interestingly arranged and accompanied by numerous illustrations. Among the subjects covered may be mentioned the grinding of piston rods, pins, car axles and wheels, valve parts, links, guide bars and miscellaneous shop tools.

POINTING, THREAD-CUTTING AND TAPPING MACHINERY.—The Webster & Perks Co., Springfield, Ohio, has issued a catalogue made up of various bulletins which describe and illustrate the different types of pointing, thread-cutting and special tapping machinery which they manufacture. The bulletins are grouped so that a separate section is devoted to a general description of each type of machine. Adjustable spring dies, and clamp die collars, optional holding devices, special holding devices and an improved geared rotary oil pump are also featured.

ADVANTAGES OF SUPERHEATED STEAM.—What Every Executive Should Know About Superheated Steam is the subject of Bulletin No. T-7 recently issued by the Superheater Company, New York. The bulletin discusses superheaters for stationary power plants and is designed to appeal to the executives and, therefore, has been made non-technical. After a brief explanation of superheated steam and the methods of producing it, the economies effected by its use are discussed, the concluding section dealing with the application of superheat to existing power plants.

FURNACES AND BLOWERS.—A thorough discussion of various types of furnaces from the practical standpoint is one of the principal features of Catalogue No. 80 recently issued by the Chicago Flexible Shaft Company, Chicago. Particular attention is given to the requirements of furnaces for porcelain enameling, but much of the information is equally applicable to the types used in railroad shops. The general requirements of furnaces are taken up and muffle and semi-muffle types are discussed. This is followed by selections dealing with fuels and refractories. Several types of furnaces are illustrated and described together with the Stewart positive pressure blowers. The melting points of chemical elements and tables for the conversion of temperatures of the Fahrenheit and Centigrade scales are included.